FEB 2 1921

Vol. LXXXVIII. No. 2252 | JANUARY 21, 1921. | Registered at G.P.O. as a Newspaper and Canadian Magazine rate of Postage. | PRICE SIXPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. 4. SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum.—NEW YORK: D. VAN NOSTRAND Co., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 29, Rue de la Banque.
Telegraphic Address: "Ageekay, Cent., London." A B C Code. Telephone Nos. City 997; Central 4425 (Editorial only).

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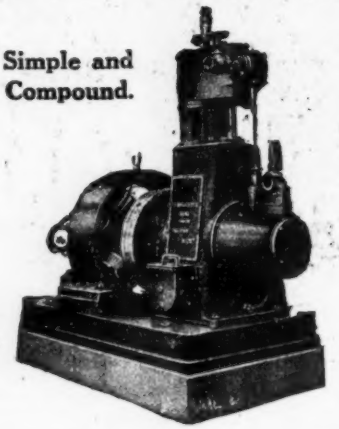

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ELECTRICAL REVIEW.

VOL. LXXXVIII. JANUARY 21, 1921. No. 2,252.

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW" SUBSCRIPTION RATES.

UNITED KINGDOM	£1 14 8	per annum.
CANADA	1 12 6	do.
COLONIAL and FOREIGN	2 1 6	do.

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The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

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UNEMPLOYMENT INSURANCE.

FOR some months past a number of employers and labour representatives have been meeting informally to discuss some of the more important problems which are pressing upon industry during this period of reconstruction, and they have come to the conclusion that the most urgent and serious of these problems is that of unemployment.

With a view to dealing with the matter more adequately than has yet been provided for under the National Unemployment Insurance Act, 1920, they have, with the aid of statistical and economic experts, drafted a scheme which they consider might be grafted upon the present Act and applied without delay.

A draft of the scheme has been sent to us anonymously in order that it may be discussed on its merits and without the names of the group being at present known, but we are assured that their credentials are unquestionable, and that the employers represent concerns having tens of thousands of workers and many millions of capital at stake. In one large works it has already been put into operation without State assistance.

It is suggested that the scheme should apply to all manual workers and to salaried workers, between the ages of 16 and 70, receiving not more than £400 a year, with the exemptions mentioned in the Act passed last year, the rate of benefit to be 50 per cent. of the average earnings, with 10 per cent. additional for a dependent wife and 5 per cent. for each dependent child under 16 up to a total of 75 per cent., but with a maximum of £5 per week, special provisions being made for the calculation of earnings in the case of seasonal or exceptional trades.

The benefits would be payable after three days' unemployment, and be limited to one week's benefit for every six weekly contributions, such benefits being payable for 26 weeks in any one year instead of for 15 as at present; the limitation of benefit to one week for every six contributions is a precaution against the work-shy, and it will be noted that in order to obtain the full benefit of 26 weeks the worker must have been employed at least part of each week during three years.

For the purpose of giving an immediate sense of security to workers, it is proposed that an adequate number of payments should be credited at the beginning, and although it is not mentioned in the scheme, if a credit should be given under this or a similar scheme, the credit might well bear some relation to the amount of employment which the insured person might be able to prove during some stated period prior to the credit being given.

The annual cost is estimated at about £56,500,000, exclusive of administration; the worker is to contribute £15,500,000 at the rate of one penny for every 10s. or part thereof of his earnings, the State to contribute £4,000,000 and the costs of administration, and the balance of £37,000,000 to be found by the employers by a levy of about 2 per cent. on the wages bill, the levy being increased or decreased in direct relation to a decreased or increased total contribution of workers.

In order that the scheme may be put into early operation it is proposed that the employers' contribution should be fixed for a term of five or seven years, the State retaining any surplus or making up any deficiency, and before the end of the term the Government Actuary would re-assess the employers' contribu-

tion for a further period based on the experience of the previous term.

The workers' contributions would be the same in all industries, but so soon as the necessary statistics were available the State would have power to vary employers' contributions in any industry according to the amount of unemployment in that industry. Contracting out would be permitted.

The underlying idea is to compel industry to create a wages equalisation fund, and to give employers an incentive to eliminate every removable cause of unemployment, and it is suggested that to alleviate suffering such a policy would be worth almost any cost, and that in practice it would be found to be as financially sound a policy as is a dividend equalisation fund.

We are informed that the scheme is meant to be an earnest attempt to solve a matter which is particularly urgent at the present time, and we are of the opinion that the scheme is worthy of consideration; whether it be put forth because of a deep consciousness of social obligations towards our fellow men or whether, as may be alleged by the cynic, it be from a desire of self-preservation in these days of industrial unrest, there can be no doubt that national good will result if the willing worker is relieved from the numbing fear of unemployment from causes over which he has, and can have, no personal control.

However much increased production may be urged by employers or by far-seeing labour leaders or be proved necessary by economists, the worker has a deep-rooted belief that the introduction of labour-saving machinery, the dilution of labour, or payment by results will render him or his fellows more liable to unemployment. The worker who is willing to place his utmost energies at the service of the community would not in an ideal State be at the mercy of trade fluctuations, whether they arose from exchange problems, change of fashion, seasonal employment, or any other cause which to-day may throw thousands of workers out of employment.

A scheme placed before us as this scheme is, with the backing of men who have given the matter serious and prolonged consideration, is worth inquiring into, and we shall be glad to open our columns for any of our readers who are willing to give their views on what in the first place is intended to bring early alleviation of a difficulty which is already assuming alarming proportions, and in the second to assure the workers upon whom the security and progress of our Empire so largely depend that honest and continuous labour will best assure them of freedom from the fear of unemployment.

Reconstitution of the National Council.

The employers' side of the District Industrial Councils for the electricity supply industry, in solemn conference assembled, has decided that a reconstitution of the National Council is advisable. Some of the District Councils, in fact, couch their sentiments in stronger terms, and say that it has *got to be done*. Anyhow, the employers' side is going to propose a radical refashioning. The supporters of the view, using a popular word, say the National Council must be democratised. The new National Council, which is due in May, is to be composed of 52 members—that is, of course, 26 for each side, employers and trade unions. Of the former 26, 13 are to be company representatives and 13 local authority representatives, so that each of the 13 District Councils will have two employers' representatives. As to election, the local authority representative is to be chosen directly by the District Council, and the nominee must be one of its own members. This means, of course, that the I.M.E.A., which at present holds the right of nomination, retires from the field. This proposition of reconstruction comes, we understand, mainly from the municipal side, the claim being that if the National Council is directly elected by the District Councils, the various local authority undertakings will more readily fall into line with the wages and other recommendations that are made. This, of course, among other arguments. As to the company representatives, some power (it is uncertain how much it will turn out to be) is left in the hands of the three associations—Power Companies Association, Provincial Committee, and London Conference. These bodies apparently are to nominate, but as there is a direction that one should be chosen from each District Council, the District Council concerned will probably claim to have some say in the matter. However, it ought not to be difficult to arrange such a detail amicably. The reconstitution presumably will necessitate a remodelling of the financial system. Up to the present, the expenses of the National Council have been met jointly by the four Employers' Associations; but with the altered scheme it looks as though the hat would have to be taken round the District Councils. Again, we think we are right in saying that the National Council at present pays no travelling or other expenses to its presumably affluent members; but it is very doubtful whether the whole of the 26 new members will be willing to put their hands into their pockets, or, shall we say delicately, be allowed to put their hands into the pockets of their individual undertakings. Hence a further prospective dip into the funds of the District Councils.

Now, as to the incidence of the re-arrangement, in the first place, it will facilitate the co-ordination of the work of the thirteen councils. On the employers' side, too, it will give machinery for formulating a common policy throughout the country on matters of principle or importance, as to the good of which there can be no two opinions. Also it will make the whole of the Whitley scheme as applied to this industry of a more homogeneous nature.

On the other hand, the new arrangement weakens any outside control. This, from the point of view of the ardent and progressive Whitleyite, may be welcomed. We have no doubt it is. But employers may be forgiven if they look somewhat askance at this new quasi-independence of the Councils. Certainly it gives the Councils a different complexion to unadulterated Whitleyism. The essence of the Whitley scheme is that all negotiations are between Employers' Associations and Trade Unions, whereas by this new proposal the Employers' Associations are, as Monsieur Beaucaire would say, "a 'leetle' in the background." Still, there is nothing to prevent an industry from departing from the formal type of council-scheme if it thinks fit.

There is one thing, the chairman will have a full team of horses to drive in this Council of 52. It may be true to say "the more the merrier," but certainly not the "handier" if work is to be got through—and it will require very skilful chairmanship to get as much done in the same time with a council of 52 as with one of 24.

As a last point, the Trade Unions have to agree. However, they ought to be able readily and also amiably to readjust their side, if the fraternal appellation with which they address each other stands for anything. Altogether there is likely to be much parleying and conferencing between now and hawthorn-tide, by which time this matter has to be settled, one way or the other.

The Bristol Inquiry.

The meeting held at Bristol with regard to the Lower Severn Electricity Scheme, and so soon adjourned, furnished one of two points worthy of consideration. In the first place the rule emerges that in all these "hearings" the promoters of the scheme should be represented by counsel. Then also the views expressed by the Chief Electricity Commissioner should afford, to everyone interested in any of the delimited areas, fruitful matter for cogitation. Sir John Snell most forcibly emphasised the necessity of every undertaker in the area realising that a Joint Electricity Authority scheme was essentially a voluntary and co-operative one; that the responsibility was laid upon every undertaking to do its best so to fit itself in with its neighbours as to make a joint scheme possible; that

everyone obviously could not have everything he desired, but that by a judicious give and take, a reasonable arrangement ought to be attainable. He deprecated strongly (though in his own judicious and dignified terms) any disposition to stand aloof while other people took the trouble to prepare a scheme, and then to regard it as an "Aunt Sally" to shy at. As we understand the principle indicated at this hearing, it is that anyone who comes along with an objection must not expect much consideration unless he can satisfy the Commissioners that he has taken every step to get his contentions favourably considered by the promoters and has failed. Conversely, the promoters of a scheme must, on any debated point, show that they in their turn have given every opportunity to each undertaker to submit his individual requests and have duly considered them. The Chief Commissioner's tactful and guiding counsel ought certainly to bear good fruit in the interval which the adjournment has afforded—and if so, the delay is fully worth while. Certainly something of a chastened spirit seemed to show itself in some of the subsequent speeches.

The National Joint Board.

The action of undertakers generally has been anything but praiseworthy in respect of the National Joint Board. In few cases has the supply industry appeared in such an unfortunate light. Now, on top of this, a motion has been passed at an important meeting of representatives of the employers' side from all parts of the Kingdom, which seems to be decidedly ill-advised, considering the actual circumstances. Certainly it shows a lack of humour. This motion, as in the case of the National Joint Council, proposes that the National Joint Board be enlarged to 52 members, being 26 on the Trade-Union side and 26 on the employers' side. The idea is, of course, that there shall be two employer members from each of the 13 District Boards. But as the motion excludes dealings with commercial staffs, the Trade-Union side of the Board is limited to the Electrical Power Engineers' Association. This suggestion, therefore, implies that the E.P.E.A. is asked to send 26 representatives to the meetings of the National Joint Board. What the E.P.E.A. has to say in this matter we have not heard. The whole proposal, of course, is a reflection of the proposed reconstitution of the National Joint Council which we have dealt with above, and in previous issues.

I.E.E. Informal Meetings.

Next Monday the "informal meeting" of the Institution of Electrical Engineers will assume a dignity to which it has not hitherto aspired—it will be held at the Institution of Civil Engineers. The reason for this change of venue is that the subject of discussion is "Improving the Usefulness of the Institution," with the President in the chair, and it is anticipated that members will attend *en masse* to set forth their views on a matter offering such magnificent scope for the exercise of imagination.

In passing, we are asked to mention that light refreshments will be served at 5.30 p.m., and not, as usual on these occasions, after the discussion has been opened.

Undoubtedly the Institution has already made great strides during the past 10 years towards more amply fulfilling its mission. It has always been a leading characteristic of electrical engineers to aim at ever-increasing efficiency, and just as they revolutionised the design and construction of the steam engine in the early days to make it approach their ideals more closely, so they are moulding the Institution to suit their needs. Doubtless there are still many ways in which the Institution can be of service to its members; we shall hear some of them next Monday, but we would remind the innovators that only those proposals which do not involve additional expense have much prospect of fulfilment under existing conditions.

Whilst on this subject, we venture again to recall the President's telling quotation from Bacon: "I hold every man a debtor to his profession, from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to be a help and ornament thereto." We have just heard a member, in the presence of many others, describe the Institution as a "wash-out." In the name and interest of many of our readers who are members of that body, we deprecate the use of such expressions; so long as a man is a member of it or of any other professional society, we conceive it to be his duty to uphold it in public, and to reserve his complaints or grievances for the appropriate occasion. It is another example of the present tendency to talk of rights rather than duties. If that had been the spirit of our warriors in the great struggle, we should have had few "rights" left by this time. Let us all remember that we should individually give as well as take; it is only by service that we can succeed in benefiting our fellow-men.

Electrical Development.

To initiate and successfully establish a new institution, embracing a whole industry, is a gigantic undertaking nowadays, when there are in existence so many rival interests competing for the attention of the individual. The fact that the British Electrical Development Association (Inc.), was developed from the small beginnings of the Heating and Cooking Committee of the Institution of Electrical Engineers, and in 19 months was able to present to the first annual general meeting a report which proved that it had in that short period "grown up" and was a fully-fledged incorporated association, with a long and weighty roll of membership and—still more noteworthy—a record of excellent achievement, speaks volumes for the ability, energy, and driving force of its originators; it augurs well for the future also, and thanks to the fortunate choice of a director full of "push and go," backed up by an executive committee of first-class men of affairs, it is safe to prophesy for the newcomer a career of distinguished usefulness to the electrical industries. It should be noted that "E.D.A." does not work only for the supply undertakings; its activities are of direct benefit to manufacturers and contractors as well, and we do not hesitate to class the consumer also among its beneficiaries—for surely a man who through the agency of the Association, directly or indirectly, has been induced to share in the comfort and convenience of the electrical way of doing things is better off than when he was in outer darkness?

But are all the benefits thus derived from the work of the Association to be pocketed, so to say, without the courtesy of acknowledgment, let alone reciprocation? One good turn deserves another, and we therefore urge those firms which have not hitherto given tangible support to the Association to mend their ways, and to become members of it while the new year is still young. Let them remember that if its efforts are so cordially appreciated as we know they are, in these early days of its existence, they will be vastly more fruitful in later years, when things settle down to something approaching the normal. The field open to electrical development is almost inconceivably immense; we have only scratched the fringe of it as yet. The public are waiting and willing to be educated in electrical lore—"E.D.A." is to be the teacher, and now is the time to equip it for its onerous duties. We therefore strongly commend to the notice of our readers the merits of this Association as a profitable investment for the moderate subscription which will help not only the subscriber but all other members of and workers in the electrical industry. At the recent annual meeting the members of the Association, who already number over 400, were furnished with a report on the work done during the preceding 18 months, and if any reader wishes confirmation of our remarks, we advise him to apply to the Director, Mr. J. W. Beauchamp, for a copy of it.

THE GREAT WEST-SEA BUBBLE.

Government Engineering Up-to-Date.

By A TAX-PAYER.

At the end of November last the taxpaying section of the public was thrilled by a communication sent to the daily and technical Press which proved that the Ministry of Transport was going to give some value for its ever-increasing salary list, and that the nation was to be presented with a "Christmas Gift" in the way of a scheme of power for almost nothing.

In the "old wicked world" before millions were tossed about like jugglers' paraphernalia, the value of a scheme, whether public or private, was, in sober matter-of-fact circles, judged largely by the way in which it was brought forward, careful and definite calculations and estimates being a *sine qua non;* and it was remembered that usually "good wine needs no bush." Nowadays, when anyone questions the idea that several quarts can be got out of one pint pot, or that unlimited wages or salaries can be obtained from a limited revenue, he is called a reactionary of the worst type; and one hopelessly out of sympathy with the times. Anyone, therefore, who opposes "power from the moon" will be denounced as a lunatic.

Unfortunately two and two continue to make four, although many friends of progress believe with Mr. Lenin that mathematics are "undemocratic," so that the value of a scheme in these days is measured mainly by its attractiveness to the man in the street. In pre-war days, judging by the way this scheme was puffed, it would have been looked upon as a "ramp" worthy of a company promoter of the "Hooley" era. The first and second "puffs" emanated from the Transport Ministry; strange to say, the first was not signed, not even by the Electricity Commissioners; but a news agency, whilst circulating a photograph of a wash drawing with a notice that the same could be reproduced for a nominal fee, "gave away" the names of the "three distinguished engineers" who were alleged to be responsible for it; and it is to be hoped that these "water power experts" were not overcome with modest departmental blushes at such an unwarranted breach of Whitehall confidence. If these gentlemen were actually responsible for the issue of this first "puff" they would be well advised in their own interest to join the staff of some "wild cat" company promoter, or a patent medicine proprietor, where such phrases as "light, purity and power," "the keen vision of the Press," and the "beautiful and romantic Valley of the Wye" would be fully appreciated.

When discussing the feasibility of the project for a storage reservoir, the following statement was made: "Some years ago such a project would have been quite impracticable of execution, owing to the low efficiency and high cost of the pumping plant which could then have been installed. Wonderful developments, however, have taken place in the evolution of the centrifugal pump, and centrifugal pumps of great size have now been designed which will raise water hundreds of feet with high efficiency." We do not know if such a statement can have been that of the alleged "distinguished engineers" of the Transport Ministry, or the muddled views of some hired "literary gent," but anyhow, outside the "civil engineering branch" it is well known that there have been no material improvements in centrifugal pumps during the last ten years, and that makers have been willing to produce almost any size for mining, dock, and irrigation work; and as far as price is concerned, since the war, this has probably gone up four to five times. Other statements of a similar value are made in the circular; it is said, moreover, that "the attractions of the scheme above outlined would appear to be limitless"; the question is whether the attractions are greater for Ministry hangers-on or for the "public that pays."

After the public had been treated to the first instalment of "ground bait," it was followed up by "corroborative detail" from a second Transport Ministry circular, the items of which should please any first-year student who has got hold of an electrical machinery maker's catalogue for the first time; hundreds of this and scores of that would be so nice to talk about. No sooner had the public begun to talk about rotary converters and pumps than the Board of Trade, not to be out-done, produced a 2d. masterpiece at an estimated cost to the Government (so we are told) of £19 for printing. After the two sets of fireworks it was like a semi-damp squib, part of which banged and the rest fizzled; it was nearly as amusing as the two circulars. The public, thirsty for information, is told at the end of the first section that the committee considers it "desirable to place our conclusions upon record at once," then, like a pictorial puzzle in a Christmas cracker, the reader is apparently asked to find a conclusion in the remainder of the report; judging by the vague terms used there does not seem to be one. It must be an important document, as the names of the distinguished committeemen are given twice; paper, as is well known, costs nothing to Government departments. Perhaps owing to the ignorance of water-power development by the bulk of the distinguished members of the committee, a sub-committee of two was appointed, Sir Philip Dawson and Prof. Gibson. Perhaps these two gentlemen walked along the Severn estuary like the walrus and the carpenter, "hand in hand," and discussed the suitability of the quantities of sand as a site for miles of power house, or perhaps even as a Disposal Board dump; at any rate, the epoch-marking report is presumably one of the results.

One sentence in the report is delightful: "We have been strongly impressed by the extravagant ideas current in the popular mind as to the availability of tidal energy"; it is doubtful, judging by the remarkable variation in the estimates of available power, whether this remark is intended as a sly hit at the "Civil Engineering Branch" of the Transport Ministry or not. While the first circular hints at ½d. a unit, the more cautious B.o.T. Committee, headed by a rival expert, pointed out that it could not get definite estimates of cost from manufacturers and designers, and that "no useful purpose would be served by endeavouring to give in this report any estimate of the cost of the scheme"; but later it says that investigations support the view that energy can be generated at a favourable rate. As capital charges are one of the largest items in power cost for such a scheme, the value of the report can be judged by this illuminating remark; perhaps it was decided that the "Civil Engineering Branch" should be let down gently. This report is remarkable for the information that this galaxy of talented committeemen (including two super-experts) has not been able to give; perhaps the report has been arranged to form the basis of a suitable road for retreat, if after examination, worthy of the name, the scheme proves hopeless. It would appear that the only people who have given much study to a Severn scheme are three gentlemen whose names appear in small print at the foot of the first page; it is not unusual, however, in Government departments to annex the work of others with scant acknowledgment.

From the practical point of view, before the war, coal power stations could compete in most cases with normal water-power stations, except where coal was very dear; that is to say, coal plus wages and interest charges was often equivalent to the usually higher interest charges on water-power plus the wages, transmission costs, and other incidentals. Quite recently Mr. A. T. Smith, of the Castner-Kellner Alkali Co., said that before

the war, with Lancashire coal, his company was able to produce power more cheaply than was possible at Niagara. No doubt, with pre-war capital charges, existing water power is in a more favourable position than it was, but with existing capital charges for new work the thing seems to be the other way; if capital charges have risen more than the price of coal, the situation regarding water power, and especially tidal power, is less favourable than it was.

The three reports are delightfully vague regarding capital cost and interest charges, but at present on these factors tidal schemes must stand or fall; nobody says that power cannot be generated. No amount of pretty talk and fashionable "eyewash" will prevent the proverbial "brick" coming through the gold foil if the scheme is not sound economically. The capital cost of works and machinery has gone up four to six times, and the interest on Government-guaranteed securities has about doubled, therefore interest charges must be reckoned as eight to twelve times those required in pre-war times; coal has gone up three to four times in most places. After allowing for the smaller capital cost of a steam power station, especially with, say, 25,000-kW sets, as against, say, 1,500-kW low-speed water turbine sets with gearing and d.c. generators, rotaries, and other stand-by plant, things begin to look a little uncomfortable. It is exceedingly difficult to-day to get heavy manual outdoor work carried out efficiently, even by able-bodied unemployed, as has been shown in iron ore mines and in reclamation work on the East Coast. If machinery has to be used in large quantities, then the politically attractive unemployment relief idea largely falls to the ground. The capital cost, energy losses, and salaries bill for miles of low-speed turbines with silty water, the d.c. generating sets and gearing, the rotaries, step-up transformers, and the capital cost and low efficiency of the storage system capable of dealing with the maximum demand must make a "poor show" when capital charges are honestly allotted. No comparison has been given regarding the cost of power generated from steam in the Wye district with duff coal or inferior fuel.

If the scheme seems sufficiently attractive from the political point of view, and that is the main thing that counts nowadays, the matter will be settled by the party Whips after a report, perhaps by a conveniently packed Commission, and not by impartial engineers of world-wide experience of actual water-power development. From beginning to end the whole scheme opens the door for log-rolling and chicanery; the original pamphlet, with its gush and political hints, indicates that very definitely. If the capital cost of the electrical branch comes out too high, millions will be debited to the wonderful dock scheme (as illustrated), to the motor road, or to the quadruple rail connection to carry the Welsh coal, or as a last resort, to the industrial Garden of Eden. If the scheme begins to fall flat, then opposition will be called lack of sympathy for the (unemployable section of the) unemployed.

It should be noted that with electric traction from, say, Patchway to Newport, the traffic through the Severn Tunnel could be largely increased; that a new bridge near Berkeley, or even a reconstructed Severn Bridge would carry motor traffic from places east of Swindon to South Wales by a fairly direct route, and that if the traffic from Devon and Somerset to South Wales is so great, it is remarkable that more ferry traffic does not take place.

Given honest dock labour, existing ports could carry much more traffic than they do; without the reconstruction of the Severn navigation and connecting canals, large barges of the Continental type could not reach the Midlands. No doubt, however, such prizes from the Geddes "Christmas tree" will be dangled at the critical moment before the gullible public.

No real estimates of capital cost are given in any of the three papers, although in the first, presumably by pure intuition, the cost of energy generated is stated to be something over ½d. a unit, the available power being there stated as half a million with a peak load of a million horse-power. In these days other people's money is mere dross, especially when handled through mushroom syndicates, and to the modern type of Government post-war official, details and estimates are superfluous, for obvious reasons.

In the old days, when a rank swindle was to be promoted it was usual to give some figures (even if conveniently "faked"), and lists of other companies and schemes were given which, more often than not, for reasons naturally undisclosed, were not comparable with the scheme to be "puffed." In the first inspired Severn puff a list of large water-power installations was given, no mention being made that none of these were tidal schemes, and it was not stated that in capital cost a waterfall plant was not comparable with any tidal plant, full use being made of the now fashionable economic "*suggestio falsi*," although in the committee's report, which the general public is not likely to read, the absence of existing tidal schemes is pointed out.

It should be noted that there is nothing new about the study of tidal schemes; something like two hundred patents have been taken out at home and abroad, and the reason why nothing was done before the war, when an honest day's work was conceivable, and Government money was available at about 3 per cent., and money for sound independent schemes at about 4 to 5 per cent., was that such a scheme could not be made to pay even in places where coal cost 30s. a ton or more. It should be pointed out, however, that at that time the nation had not available the services of the Transport Ministry with its "distinguished engineers," or the Water-power Committee of specialists, the simultaneous assistance of the Central News, or the creative ability of the engineering artists on the staff of the *Daily Mail*, let alone the "taxpayer's joy," the Government Wire-pulling and Publicity Staff "Unlimited."

The French Government, which has at its disposal some of the most distinguished water-power engineers in Europe, has not filled the popular Press of Paris with company promoters' "tosh" first, and then begun to look into such minor details as capital cost afterwards, but has voted a sum of money for experiments on tidal turbines and tidal schemes, and the question is being examined by engineers whose names carry some weight in connection with water power. Such methods would naturally not appeal to those whose existence in Government employ has to be justified by advertisement; the French Government should send over to Whitehall to learn how to do these things properly. It is interesting to note that most schemes of tidal power abroad are based on double reservoirs and not on the single dam system.

In the past Government interference has been little less than disastrous to the electrical industry, and if the way in which the Severn scheme has been put forward is to be taken as a guide for the future, the less Whitehall interferes the better; if the scheme is sound, men of action will be found to carry it through; if it requires Government fireworks to make it popular, it ought to be left alone.

Until a comparatively high-speed, variable-head turbine with a constant speed, or a simple reliable generator producing three-phase current with a constant periodicity with a variable speed is invented, it is very little use talking about a Severn scheme, especially as long as interest on money remains at its present level, and labour refuses, even with periodical bribes, to do an honest day's work. There are few schemes in which engineering and finance are so completely intertwined as a tidal power proposition, and judging by the way it has been "boosted," for ulterior motives, one is entitled to say that "fools rush in where angels fear to tread." A mixed scheme in which a railway, a roadway, a dock, an electricity supply, and unemployment are mixed up should be handled only by men of absolute impartiality with a reputation for large general engineering and hydraulic power schemes; and apart from a grant for independent study, no more advertising "stunts" should be allowed until figures and plans are produced and published which will bear investigation.

THE ELECTROLYTIC STERILISING OF WATER.

[COMMUNICATED.]

It is interesting to note the keen go-ahead methods of our Colonies. Towards the end of the war period, a large Colonial dairy, having seen an account of the electrolytic sterilising of water, telegraphed without further parley for a plant to be sent out, which was the forerunner of many similar installations. In this country there is a much larger field for water sterilising, yet it remains practically untouched.

There are many systems to choose from, but the electrolyser has strong claims for favourable consideration. Bleaching-powder solution and chlorine gas have been employed with success, but they impart a nauseous taste to the water, calling for a further dechlorinating process, which is unnecessary where the type of electrolyser which produces neutral hypochlorite is employed. The hypochlorites are essentially unstable, particularly so when neutral, and for this reason they are eminently suited to the sterilisation of drinking water, as any slight excess employed—and it is necessary, for complete sterilisation, to employ an excess—which does not combine with organic matter is quickly decomposed by sunlight into hydrochloric acid and oxygen; there is then no free chlorine left to impart an unpleasant taste to the water. The amount of hydrochloric acid in the water is negligible; the total quantity of hypochlorous acid employed is only 0·5 part per million, and by far the larger portion of this combines with organic matter, leaving probably only 1 part in 10 millions to be decomposed.

The importance of pure water in industry is not always readily recognised, particularly where it is fairly clean; yet water which is charged with peaty or vegetable matter is known to be a fruitful cause of pitting and corrosion in boilers. Water drawn from reservoirs where weeds flourish is unfit for humidifying rooms where manufacturing processes are carried on, as it is apt to impart an unpleasant odour to the air; such water is also unfit for making tea, or drinking generally. Where there are weeds there will be snails, and other organisms; the snails get into the pipes and under valve seatings, the weeds are drawn into the pipes and choke them. The transparent eggs have been known to produce strange markings on cloth which is being finished, and mildew spores carried by water cause trouble in the material under treatment, and in the woodwork of the establishment.

Water which is clear and free from odour, is often seriously contaminated, and is the means of spreading epidemics; cattle drinking it apparently do not suffer, but cows convey the diseases in their milk. Fluke in sheep is liable to be conveyed by water, hence the farmer, quite as much as the manufacturer, has every reason to examine the purity of his water supply. Electrolysers can be profitably employed wherever there is a few horse-power to spare, as rough coarse salt, the other requisite, is always available. Skilled supervision is not demanded: ordinary steady workmen as a rule are perfectly capable of attending to the plant.

There are many other uses to which this harmless sterilising agent may be put. For example, a little of the liquor added to the water employed in washing bacon assists in removing the slime and rancid flavour: it also prevents fish from becoming tainted so soon in hot weather, and this process is preferable to some of the methods employed.

The electrolyser is largely employed in laundries, the liquor used being an excellent bleaching agent, which does not injure the clothes, and removes the odious smell of perspiration which remains as the result of imperfect rinsing. In hospitals it sterilises infected clothing, and the liquor is used for flushing drains, replacing expensive disinfectants. For bleaching cotton and linen, it rivals the old grass bleach, and it is also the most suitable medium for bleaching cotton-wool, surgical gauze, &c.

THE FARADAY SOCIETY.

The Atomic Theory and the Structure of Iron.

A paper presented to the Faraday Society at the December meeting by Prof. E. D. Campbell, of the University of Michigan, on "A Force Field Dissociation Theory of Solution Applied to some Properties of Steel," led to an interesting discussion on atomic structure generally. The paper was presented and the discussion initiated by Dr. A. E. Oxley, who has in recent years put forward suggestive ideas on the structure of the atom which physicists will have to take seriously into consideration.

The central idea of Prof. Campbell's paper is that steel is a solid solution of carbides in iron, and that there is no essential difference between a liquid solution and a solid solution. He considers that the use of the latter term is largely to blame for the unnecessary obscurity that has arisen as regards the constitution of alloys, while a subsidiary cause has been the difference in the mode of expressing the composition of alloys and of ordinary solutions. In the former case percentage by weight has been the vogue; in the latter the far more scientific procedure has been adopted of molecular or atomic concentration per unit volume. The transformation from one to the other is a simple process, and Prof. Campbell redraws a portion of the ordinary iron-carbon diagram with composition expressed in milligram atoms per centimetre cube. It is not, however, the Arrhenius dissociation theory which Prof. Campbell adopts for ordinary solutions and applies to the case of steel—he considers that entirely untenable for a solvent that is not a dielectric but a conductor. (He overlooks the fact that this constitutes a genuine difference between an aqueous solution and an alloy.) Instead, a theory first put forward in 1915 independently by Prof. E. C. C. Baly in this country and Prof. Campbell himself in America is described, and shown to be closely applicable to the case of steel and capable of explaining its properties, and in particular the effect of the alloying constituent on its electrical resistivity. This so-called "Force-Field Dissociation Theory" postulates that in a molecule the electromagnetic field of force associated with the constituent atoms is normally closed in combination in the molecule. In solution, however, the force field is more or less opened out by the solvent, to a degree depending on concentration and on the composition of solvent and solute. It is to the field of force thus set up outside the molecule of solute that the reactivity of ions is due, and not to electric charges as in the Arrhenius theory. It is the products of ionic dissociation of carbides in solution which react when a p.d. is set up in steel, and electronic motion of electricity is converted into atomic or molecular motion of sensible heat, while conductance of the electric current takes place through the solvent iron. Thus the products of ionic dissociation in a metallic solution are capable of reacting with electrical energy just as truly as are the ions in an aqueous solution, but the result of the reactivity is electrical resistance in the former case and conductance in the latter case; the reversal of the phenomena being solely due to the solvent being a conductor in one case and in the other a dielectric.

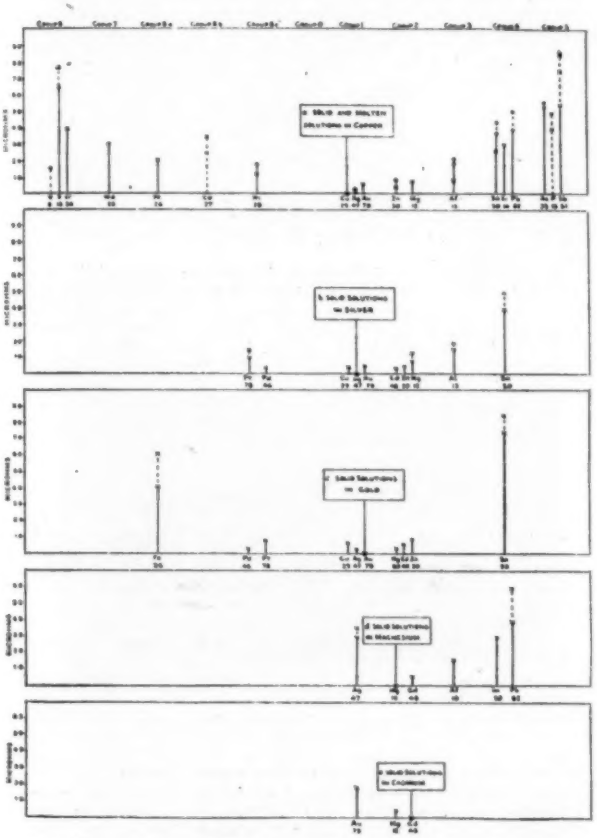
Dr. Oxley, in commenting on Prof. Campbell's theory, agreed that a stray electromagnetic field would exist outside but close up to an atom or molecule that on the whole was electrically neutral, but he did not think that force field was competent to account for the phenomena of solution—Arrhenius's dissociated ions were required in addition. That he thought was proved by the evidence for the lattice structure of crystals which the well-known work of the Braggs had led up to. On the other hand, the phenomena of diamagnetism and paramagnetism did require that in an atom there should reside something which acted as a unit of magnetism, a magneton, as well as the electron unit of electricity. Thus, the Rutherford-Bohr "solar system" atom, which admirably explained spectral phenomena, failed utterly to account for the diamagnetic or paramagnetic properties of matter. Dr. Oxley then outlined his own modification of Langmuir's cubic atom theory, which imagined that the nucleus and electrons were arranged in a sort of cubic formation, the electrons being at the corners of the cube. This theory had been brilliantly successful in explaining chemical affinity and many physico-chemical properties of matter. It was only necessary—Dr. Oxley suggested—to suppose that the electrons instead of being fixed rotated in tiny orbits round their central positions, or were themselves little vortices or rings, to have the required unit of magnetism, and it could easily be seen how the magnetic properties of matter would fall into the scheme. Unfortunately, to work out this theory completely and quantitatively presented formidable mathematical difficulties at present.

The all too short remainder of the evening was given to the hearing of a very excellent and suggestive paper bearing on the same subject by Mr. A. L. Norbury, entitled "The Electrical Resistivity of Dilute Metallic Solutions." It is of interest to note in passing that Mr. Norbury *pace* Prof. Campbell strongly advocated the retention of the term and the idea of solid solution—to distinguish it from the liquid or molten metallic solution. The starting-point of Mr. Norbury's conception of metallic solid solutions—or alloys—is the well-known fact that a small quantity of impurity in solid solution in a metal causes a large increase in the electrical resistivity of a pure metal. With enormous industry Mr. Norbury has collected all existing data in this connection and plotting resis-

tivity against composition expressed in terms of atomic concentration (in this he yields to Prof. Campbell's requirements) he has arrived at relationships of very great interest.

Dealing for the moment with individual alloys, we find a broad distinction between those in which the constituents are mutually insoluble and those in which continuous solid solutions are formed. In the former case each crystal grain may be regarded as a separate conductor. In so far as the arrangement of grains tends to be in the nature of conductors arranged in parallel the *conductivity* is a linear function of the composition; in so far as they tend to be arranged in series the *resistivity* is a linear function of the composition. In the latter case the initial additions of solute normally cause a linear increase in the resistivity of the metallic solvent. Cold work and variations in grain size have little effect on the resistivity of pure metals. In the case of binary alloys the grain size has an increasingly large influence, as the number of atoms forming the crystal boundaries becomes comparable with the total number of atoms present.

The most important section of the paper dealt with the effects of various elements in the resistivities of iron, nickel, palladium, platinum, copper, silver, gold, magnesium, cadmium, sodium and potassium. The generalisation arrived at will be best appreciated by reference to the accompanying figure. The



THE ATOMIC EFFECTS OF VARIOUS ELEMENTS ON THE ELECTRICAL RESISTIVITIES OF COPPER, SILVER, GOLD, MAGNESIUM AND CADMIUM.

(The uprights indicate: Increase in the Resistivity of the pure Solvent (in microhms per centimetre cube) due to the Presence in Solution of 1.0 Atomic per cent. Added Element. Solid Solutions thus x, Molten Solutions thus * at 1100°—1400°.)

results should really be plotted in three dimensions, the dimension not indicated being that showing the vertical arrangement of the elements in the Periodic Table. In order, however, that the vertical positions may be more readily imagined, the atomic numbers are written in under each of the solute elements.

It will be noted that the atomic effects of the solutes are plotted against the positions in the Periodic Table, and the remarkable result is brought out, that the atomic effect of a solute on the resistivity of a metallic solvent is large or small according as the solute is far from or near the solvent in the Periodic Table. Many other interesting relationships can be deduced, but for the discussion of these reference must be made to the full text of Mr. Norbury's paper. They all bear on the generalisation that the atomic resistivity effects of various elements as solutes in solid solution in a metal are large or small according as the solute differs from or resembles the solvent in some atomic property.

Various atomic properties were examined in an endeavour to find which of them would explain the results. Atomic volumes, intrinsic pressures, electrical resistivities, thermo-electric properties and decomposition potentials failed to do so. It is suggested that the results may be explained by assuming that the relative atomic effects are small when there is little electrical attraction between the atoms of solute and solvent, and large as this attraction becomes greater.

If one atom of solute in a very dilute solid solution is pictured, and if, for example, the face-centred cube lattice is assumed, it is known from the work of W. H. and W. L. Bragg that this atom of solute is surrounded by twelve equidistant atoms of solvent. It is thought that the solute atom will not be attached, providing the solution is sufficiently dilute, to any one of the twelve surrounding atoms in particular, although there may be strong "affinity" forces at work tending to cause such combination.

The above non-formation of inter-metallic compounds will, however, only occur in very dilute solutions. As the solutions become more concentrated some of the atoms of solute will tend to "combine with" (that is to say, a transference or regrouping of electrons will take place) definite atoms of solvent to form inter-metallic compounds. It is noteworthy that the useful alloys, those with good mechanical qualities, do not contain intermetallic compounds, but consist purely of solid solution.

The generally accepted view on metallic conduction is that metals conduct an electric current by means of their "free" electrons. It seems in accordance, therefore, with the above view to explain the relatively enormous effects produced on a metallic conductor by the introduction of a few foreign atoms, by assuming that the increased resistivity is due to the solute atoms exerting restraining forces on the electrons of the neighbouring atoms of the solvent and vice versa.

To take an actual case, the fact that the addition of 1.0 atomic per cent. arsenic sends the specific resistivity of copper up by four or five microhms (this effect is apparently almost equally great near absolute zero where the resistivity of pure copper approaches 0.0) makes it seem very probable that each arsenic atom is exerting a very considerable influence on the resistivity of a large number of the surrounding copper atoms. It is thought that it would be difficult to explain such a relatively large influence unless it is assumed that the electrons in a large number of the copper atoms are being affected.

We are glad to learn that Mr. Norbury is continuing his excellent work, and is carrying out experiments which will enable him to fill up some of the gaps in existing data. He will then be in a position to put his views to a strict quantitative test, and thus help to throw more light on phenomena that are not only of great theoretical interest but bear closely on matters of technical importance.

THE PHYSICAL SOCIETY'S EXHIBITION.

(*Continued from page* 40.)

MESSRS. SIEMENS BROS. & CO., LTD., showed about half a dozen instruments which included different patterns of temperature indicators; a suspended-coil temperature recorder, fitted with a continuous chart roll driven by clockwork, and suitable for use with thermo-couples or resistance thermometers; and a locomotive pyrometer for measuring the temperature of superheated steam.

MESSRS. NEWTON & CO. exhibited a selection of optical lanterns for educational purposes, which although not new have been remodelled. Arc lanterns were demonstrated which are suitable for ordinary work as well as open-stage, vertical, and opaque projection. Various attachments were also shown by the use of which the lantern can be adapted for use with a low-power projection microscope, polariscope, micro-polariscope, and spectroscope. The "Episcope" was specially constructed for the projection of opaque objects, such as diagrams, maps, and small natural objects. In the lantern shown a drawing up to 27 in. wide and of indefinite length could be placed in position, the actual field of projection being about 11 in. square. An attachment was provided so that ordinary slides could be used as well, and two high-c.p. gasfilled lamps supply the light.

MESSRS. CHANCE BROTHERS & CO., LTD., demonstrated certain properties of ultra-violet light, isolated by the use of their special glass, particularly with reference to the effect on the eye, and the protection from the rays which may be afforded by Crookes and certain coloured glass. The subject is of special significance in connection with the protection of operators performing electric welding. A sample of "Daylight" glass was shown, which is claimed to give a daylight effect when used in conjunction with gasfilled tungsten lamps. Another interesting exhibit was the glassware of high thermal endurance; it was demonstrated that water can be squirted on to this glass when the latter is heated to a high temperature, without causing any injurious effects whatever.

MESSRS. CREED & CO., LTD., demonstrated the reception and automatic printing of wireless messages in Roman characters. Mr. F. G. Creed's ingenious method is the only one that has been adapted to print wireless messages. The system consists of a combination of existing Creed printing telegraph apparatus working in conjunction with groups of thermionic

valves. The message is first translated into the Morse code by perforating a strip of paper in a keyboard device so contrived that each key punches the strip, by means of a solenoid-operated mechanism, with the Morse equivalent of the letter in question. The strip is fed to the transmitter which sends out Morse dots and dashes, the latter actuating a transmitting contact maker. Several sizes of transmitter have been developed, including one which is worked by an electro-pneumatic relay and which is capable of dealing with as much as 300 kW; it has eight sets of contacts each breaking under an air blast. Reception is by thermionic valve, and the incoming messages are amplified considerably by means of valves in cascade. Current impulses are thus supplied to the relay magnet of a Creed receiving perforator of the same type as those used in line telegraphy and operated by compressed air; the working speed may be up to 200 words per minute. This is an interesting device, but an electrically-driven pattern is now being produced on a mechanical principle which is stated to be simpler, more compact, and which will dispense with the use of compressed air. The strip from the receiving perforator, still in the Morse code and the exact counterpart of that used at the transmitting station, is next fed to the Creed printer for translation into Roman characters. This is a purely mechanical device, and forms an automatic typewriter controlled entirely by the position of the holes in the perforated strip; the working speed is 120 words per minute, and it is a remarkable piece of apparatus. The whole apparatus is driven by an electric motor, so that no external source of compressed air is required. An improved form of printer has also been developed which does not employ compressed air, is more compact, and has a higher printing speed, but it has not yet been adapted to wireless reception. The Creed system of wireless reception, using compressed air, is capable of dealing with a transmission speed of 180 words per minute. This speed is in excess of that of the printer, but the improved printer will be able to keep pace with the receiver and deal with a 50 per cent. increase in transmission speed.

The Cambridge & Paul Instrument Co., Ltd., besides other instruments, included in its exhibit a Rosenhain inverse rate recalescence curve tracer (fig. 4), which was designed to allow of the semi-automatic plotting of "inverse rate" heating and cooling curves. In such curves the quantity plotted is the time taken by the specimen to heat or cool through successive

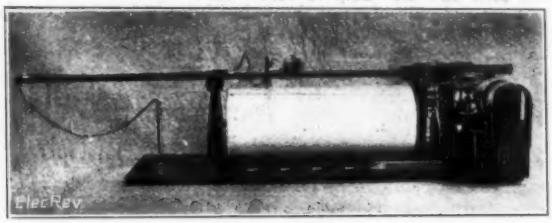


Fig. 4.—The Rosenhain Plotting Chronograph.

equal temperature intervals, and the use of this instrument does away with the laborious plotting by hand of the time intervals obtained by the use of an ordinary chronograph. The recorder consists of a revolving drum, carrying a chart, over which the recording pen moves at a definite rate. At the end of each time interval, when the observer taps a key, the pen marks the chart, indicating its position, and is immediately afterwards returned to zero, while the drum is simultaneously advanced one step. After a short period of rest, introduced in order that the times of the forward movements of the pen shall not be altered by the varying times taken by the pen in returning to rest after long or short deflections, the pen once again moves forward at a steady rate until its progress is stopped by the observer again tapping the key at the end of the next temperature interval. Curves are obtained on an open scale, the rate of travel of the pen being usually 3 mm. per second. A two-speed arrangement is, however, provided, to reduce the speed of the pen to one-quarter of this when the pen has reached the middle of the drum. This is necessary on account of the fact that long arrests in the heating or cooling process may occur, and during these the pen at the normal rate of travel would be carried a greater distance than the width of the drum.

The details of the driving mechanism are as follows: Two vertical spindles, each carrying small disks, are revolved in opposite directions at constant speeds, the speed in one case being more than ten times that in the other, of which the periphery moves 3 mm. per second. Running on guides between these two disks is a light wooden bar, carrying the pen, below which is the drum. Normally, the bar is held by a spring against the slowly moving disk, and the pen travels outwards over the surface of the drum at the rate of 3 mm. per second. When, however, the tapping key is pressed, an electro-magnet is excited which overcomes the tension of the spring and presses the bar against the quickly moving disk, causing it to return at high speed to the zero position. In order to provide the period of rest referred to above, the electric magnet, being once excited, is caused to remain in action for a definite period before the pen arm is allowed to start on its return journey. The two-speed arrangement is secured by mounting a second driving disk of smaller diameter on the same spindle as the first. The wooden bar is so shaped that for a distance equal to half the width of the drum it bears against the large disk, but after that the bearing is upon the small disk, with a corresponding reduction in the speed of travel.

The machine running recorder exhibited was designed for Messrs. J. & A. D. Grimond, Ltd., Dundee, for recording the number and duration of stoppages of 50 textile machines. Each machine is connected up to the instrument in such a way that when the machine stops an electrical circuit is completed to contacts in the instrument, each of the 50 machines being connected to one of the 50 contact studs arranged in a circle, as seen in fig. 5. A rotating switch runs over the 50 contact studs, being driven by a small electric motor of ¼ h.p., and so geared that it passes over all the contacts once in six seconds. The records are made on a continuous paper chart, passing over a brass cylinder, by means of an inked roller carried at the end of an arm swinging across the surface of the chart. A cam on the main spindle which carries the rotating switch causes the recording arm to swing completely across the paper from right to left as the switch passes across the 50 contacts, and returns the arm to the extreme right-hand position before the switch again starts to travel across the contacts. If none of the contacts is energised, *i.e.*, if all the machines are in operation, the inked roller does not touch the chart, but when the circuit is completed by the stoppage of one of the machines, an electro-magnet on the recording arm is energised, causing the inked roller to be momentarily pulled downwards and mark the chart. If this contact is still closed when the switch next passes the corresponding contact stud, the roller will be once more pressed on to the chart, which is moved forward a short distance after each revolution of the contact switch. Consequently a series of marks, forming a straight black line on the chart, is made during the whole time any machine is out of operation.

The instantaneous photometer shown was designed for the Admiralty in conjunction with the staff of H.M.S. *Vernon* for measuring the instantaneous candle power of an electric lamp when it is lighted up or going out. The comparison is always made with a similar lamp, which has been previously cali-

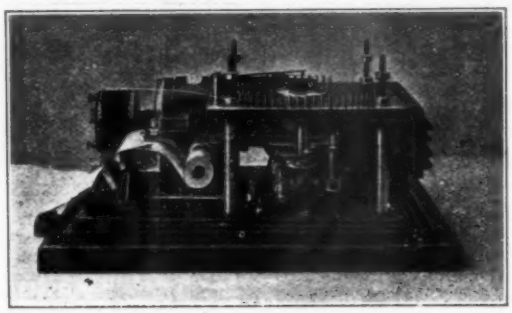


Fig. 5.—Machine Running Recorder.

brated with varying currents in an ordinary photometer. The lamp to be measured is placed in an upper box and the comparison lamp in a lower box; the comparison lamp is then run steadily with different currents below and up to its normal current. The insides of the boxes are painted white, and the two lamps illuminate slits covered with opal glass. Disregarding the effect of the shutter for the moment, light from these two slits passes through two cylindrical prisms with vertical axes to a double prism with horizontal axis in the eyepiece, and the light then passes in two nearly parallel beams to the eye. The latter prism is observed through an ordinary eyepiece, so that the observer sees two adjacent rectangular fields, the upper illuminated by the lower comparison lamp, and the lower by the lamp under test. The revolving shutter carries another pair of slits. Light only reaches the eye when the two pairs of slits come into line with the eyepiece, so that the eye only perceives flashes lasting about 0.001 second. The two revolving slits are independently adjustable on both sides so that the two flashes can be made simultaneous and of equal duration. To avoid carrying the obscuring screen completely round, a second shutter obscures the lamps when the revolving slits are far away from their operating position, the secondary shutter being opened by the revolving slits in good time before the slits themselves come into action. The revolving shutter also carries a cam which operates the switch controlling the lamp under test. The contacts are carried on a large wheel under the revolving slit. By rotating this wheel the position of the contacts is moved so that the cam lights up or, alternatively, switches off the lamp at a varying interval before the shutters open. As the motor revolving the shutter and cam is fitted with a centrifugal governor, the speed of revolution is constant at 30 r.p.m., and the wheel carrying the contacts can be calibrated accurately in units of time. One half of the wheel is calibrated with white

figures in hundredths of a second, from 0 to 1 second, representing intervals of time after lighting up, and the other half of the wheel is similarly calibrated in red to represent intervals of time after switching off.

Other instruments shown were totally-enclosed pyrometer indicators, a McGregor-Morris anemometer (ELEC. REV., September 10th, 1920, p. 345), a "Cambridge" thread recorder, a six-string galvanometer, an electrical CO_2 indicator (Shakespear patent), &c.

THE COX-CAVENDISH ELECTRICAL CO., LTD., exhibited X-ray equipment for the routine examination of materials of low density by means of a conveyor band which is made to pass beneath the screen. A new X-ray plate was also shown by the use of which it is claimed that exposures may be reduced to 1/25th of the normal.

MESSRS. CUTHBERT ANDREWS'S exhibit consisted of a show case containing a number of modern X-ray tubes of British manufacture, together with protective devices, such as aprons, gloves, masks, &c. There were also shown electrodes for use in high-frequency treatment, and an improved Walter pattern of penetrometer for estimating the penetration of X-ray tubes; a practical demonstration of the making of small pieces of bench-blown glassware was given.

THE FOSTER INSTRUMENT CO.—Everything on this firm's stand was shown working. A portable pyrometer indicator of "Resilia" construction, was mounted upon a "bumping" stand to demonstrate its robustness; it was calibrated for a Hoskin's alloy thermocouple outfit. A special spring mounting was utilised in the millivoltmeter shown to provide a very open scale, allowing fine readings without the errors possibly introduced by set-up zeros; the readings may be made with ease to 0.2 per cent. of the scale. The instrument, which was fitted with an enclosed rotary switch and a lamp for illumination, was mounted on a swivel bracket and calibrated as an indicator for platinum-platinum-rhodium thermo couples. Various other pyrometric outfits and accessories were shown in addition to a Humfrey autographic notched bar and an Eden-Foster repeated impact testing machines.

MESSRS. CROMPTON & CO., LTD., claim special advantages for Robertson's combination bridge and potentiometer, which was designed for educational laboratories to meet the double purpose of an ordinary four-gap slide-wire bridge and a simple form of potentiometer; the list of experiments which can be carried out by means of the apparatus is extensive. The stroboscopic vibrator that was demonstrated consisted of an electrically-maintained tuning fork of large size, which was arranged to periodically admit light to the eye or to the body in motion. It can be driven by energy derived from two storage cells, and can be started by gradually turning the regulating screw until the platinum contacts touch, and the amplitude of the vibrator can be adjusted by the same screw. Each limb of the fork is surmounted by an aluminium vane in which slits are cut; by means of two thin slits, each equal to the amplitude of the arms, placed directly opposite when the fork is at rest, slit vision can be obtained giving glimpse frequencies of 12,000 per minute. By means of the second slit, which is normally covered by the edge of the vane, but which is periodically uncovered when the vibrator is in action, edge frequencies of 6,000 per minute can be obtained. The firm's low-voltage potentiometer for pyrometry has several novel features, the chief of which is that the standard resistance coils are made of manganin, and all the connecting studs for contacts of copper, thus ensuring freedom from thermo-electric forces within the instrument itself. The range is up to 20 mV, but a change-over switch is provided for converting the instrument into a standard potentiometer with a range up to 2 volts. The Kelvin bridge shown had both variable ratios and variable standard. Variation is obtained by means of switches under glass, and the coils and slide are inside the box, but can be inspected by removing the sliding bottom.

MESSRS. EVERETT, EDGCUMBE & CO., LTD.—This exhibit, although not as large as we have known it in past years, nevertheless showed a wide range of measuring instruments, from the 2-in. dwarf pattern for X-ray and medical requirements to the 18-in. illuminated-dial sector for use in large power stations. The "Metrohm" insulation testing set, incorporating a self-contained hand generator, has a particularly long and open scale, and the "resistance metrohm" or direct-reading ohmmeter can be supplied for any range of resistance. Other exhibits included frequency meters of the moving-iron and resonance types, rotary synchronisers, relays, graphic recording instruments, and measuring instruments of various patterns. The "rotary" pattern of power-factor meter is particularly suitable in cases where the flow of power is liable to change its direction, and the precision with which the reed is picked out in the vibration tachometer, which is based on the principle that the speed of a rotating machine is determined by the vibration of a tuned reed resonating with the periodic vibration of the machine, is remarkable. The "Luxometer" hand photometer, by means of which candle power, illumination, brightness, and window efficiencies can be measured seems likely to be of considerable assistance in connection with factory lighting. It is claimed that the instrument affords a reliable guide to the efficiency of daylight illumination.

THE WESTON ELECTRICAL INSTRUMENT CO., LTD., exhibited pivoted moving-coil and dynamometer types of laboratory instruments with an accuracy, it was claimed, of at least 1/10 of 1 per cent. either in d.c. or a.c. circuits of any frequency up to 133 cycles per second. Portable precision current and potential transformers were shown for use with the standard testing and measuring instruments; the latter are said to have a normal accuracy of ¼ per cent. of the full scale reading. Other exhibits comprised pyro milli-voltmeters for use in connection with thermo couples, and sensitive pivoted moving-coil micro-ammeters, in addition to various patterns of d.c. and a.c. switchboard instruments, and thermo ammeters and galvanometers for radio frequencies. The miniature precision d.c. instruments showed exceptional mechanical construction and finish; the moving system weighs only about 5 grains, and the pointers used are made of specially drawn aluminium tubing which has a wall thickness of under 0.001 in. The tail of the pointer is 0.01 in. in diameter, and is threaded with 500 threads to the inch, so as to carry the small balance weights which are used for the accurate balancing of the movement.

THE ZENITH MANUFACTURING CO. showed a range of standard resistances of various types, and tandem projector-arc resistances arranged to work two arcs alternately and maintain the load constant on the generator. Magnetic rectifiers were shown in operation; they are suitable for rectifying either one or both halves of the complete a.c. cycle, and the latest pattern is fitted with a device which ensures that the charging current will flow in the correct direction independently of the way in which the accumulator cells are connected as regards polarity.

THE CONCORDIA ELECTRIC WIRE CO., LTD., had a show case containing wire suitable for a variety of uses and covered with different substances. Samples of nickel-chrome wire and ribbon such as is used in the manufacture of elements for heating and cooking apparatus were also on view.

(To be concluded.)

THE GERMAN ELECTRICAL AND STEEL COMBINATION.

THE shareholders in the two German electrical companies which are entering into a community of interests with coal and steel companies—the Gelsenkirchen Colliery Co. and the Deutsch-Luxemburg Mining & Ironworks Co.—have now approved the terms of the agreement of the proposed association. At the meeting of the Schuckert-Electricity Co., on December 28th, the method of pooling the net profits was explained. It was stated, for instance, that the Gelsenkirchen Co., the Deutsch-Luxemburg Co., and Siemens & Halske Co. would each receive 100 parts of the profits, while the Schuckert Co. would participate to the extent of 45 parts. The meeting decided to issue 6 per cent. preference shares for 70,000,000 marks.

The speech delivered by Herr C. F. von Siemens at the meeting of the Siemens & Halske Co., on December 28th, of which an abstract is given below, should be premised by an explanation of the terms used with reference to vertical and horizontal communities of interests. The latter are associations of interests of firms producing the same or similar classes of products, while the former comprise amalgamations or interconnections of works whose products complement each other, and lead from raw materials up to highly finished manufactures. The meeting sanctioned an increase in the share capital by 4,000,000 marks to 130,000,000 marks, and the issue of 6 per cent. preference shares for 130,000,000 marks.

HERR VON SIEMENS'S VIEWS.

Herr C. F. von Siemens, dealing first with the advantages expected from a close co-operation between various branches of industry, stated that the solution of coming years and the distant future was represented by the highest technical development of material taking into consideration that its final object was the maximum economic utilisation. In such technical progress would also be found the economic forces which would render it possible again to take up the contest in the markets of the world, and combinations must take place for that purpose. It would, however, be impossible to decide in general whether the vertical or the horizontal structure was the more correct. The company had reached the conviction that in the present case, and without falling into the errors of a fixed mould, the principle of the vertical combination must be adopted, as it was necessary in present times, both for the producer of raw materials and of semi-finished products, to occupy himself more fully with their conversion into manufactures. At present, when intelligence and valuable human labour only remained in their possession, they must take care that the little material they could derive from the soil was placed on the world's markets only in a highly improved or finished condition embodying a lot of labour. It would be impossible for the Germans to create a world monopoly. At the most they could build up artificial monopolies in the country, but only in certain cases would these obtain a better utilisation of the material, and thereby

a cheapening of the final product. A combination in common progressive work between individual vertical members of industrial life was no monopoly and no restriction of any kind whatever; it sought for its superiority in free competition at home and abroad solely in technical and economic perfection. An inland monopoly would only receive an incentive to progress when it had to fight against other foreign monopolies in the world's markets.

Coming to consider the essential points of the agreement forming the community of interests, Herr von Siemens explained that unceasing co-operation could only be guaranteed when an internal economic unit had been created which worked solely according to technical and economic points of view, and excluded separate financial interests. As a consequence the fundamental tendency of the agreement was that all the companies could only have a common economic object; and precautions had also been taken that separate advantages could not be created through a dissolution. The common economic interests would be formally watched over by a head organisation bearing the name of the Siemens-Rhine-Elbe-Schuckert Union, which would be specially concerned with the guiding lines for the general business policy and the financial measures. In the first place, consideration had been given to the necessity of leaving freedom of action to the individual members, and therefore the feeling of responsibility of their managers was fully maintained. The internal co-operation was to be attained by an interchange of directors between the companies. As to the question of the distribution of profits, the chairman stated that precise values could not be determined in present times owing to the continually changing values. It had, however, been agreed that each partner should have the same share in the financial proceeds with the exception of the Schuckert Co., which as a result of being a smaller undertaking, would receive 0.45 of one share instead of a full share.

The chairman proceeded to state that the community of interests conferred an enlarged security on the shareholders, as the risk was divided in a double respect, namely, according to professional and territorial points of view. If political difficulties arose in one part of the country which hindered an economic conduct of business, it could probably be assumed that this would not be the case in other districts, and the industry would be maintained at least in some parts of the community. Financial economic advantages would result from the better distribution of the stocks of raw materials and of semi-finished products. There was no intention of obtaining the requirements of one undertaking exclusively from the others. The mutual requisitions of materials in the best case would only form a small part of the total production of the individual members, but the agreement ensured the procuring of raw materials in times of extreme scarcity. In conclusion, the chairman expressed the hope that through this close connection between the old Mark, Rhineland, and South Germany, a new bond would be formed between important parts of the country, which would show the world that the Germans were united and wished always to remain united.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Handy Concrete Mixer.

Labour is such an important item in present-day building costs that it pays to use machinery even on a comparatively minor operation. That this is being recognised is proved by the popularity of small concrete mixers, which are being successfully used under circumstances which would have been considered impossible a few years ago. The Westminster Electric Supply Corporation, Ltd., has recently purchased a Jaeger concrete mixer for use on the building and street works which the company has frequently to carry out; the Corporation undertakes its own contracting, and the accompanying illustration shows the mixer in use on the reconstruction of the

FIG. 1.—JAEGER CONCRETE MIXER IN USE.

boiler house at Eccleston Place, where certain steam-raising plant is being removed to make way for transformer chambers —this being part of the scheme for converting the old steam generating station at Eccleston Place into a sub-station. It is anticipated that the mixer will be of considerable use in connection with the foundations for new machines, and for concreting in the long runs of trench work required for mains extensions.

The Jaeger concrete mixer referred to, which is supplied by MESSRS. MILLARS' TIMBER AND TRADING CO., LTD., of Pinners' Hall, E.C.2, is, on account of the ease with which it can be moved from one job to another, particularly adapted for such work as that undertaken by the large electricity undertakings, where, as a general rule, and especially as regards work carried out in public thoroughfares, speed is essential.

A Mercury Circuit Breaker.

THE ABSOLUTE CON-TAC-TOR CO., of Chicago, has placed on the market a hermetically sealed circuit-breaking device which can be used as a switch or to make and break an electric circuit rapidly. The contactor (fig. 2) consists of a glass tube containing a certain quantity of mercury, an inert gas to prevent oxidation or combustion, and two central electrodes with a gap between. The electrodes are connected to outside brass caps at each end of the tube. The simplest type of these contactors is operated by being tilted so that the mercury makes and breaks the circuit between the electrodes.

FIG. 2.—A MERCURY CIRCUIT BREAKER.

In the relay form of construction the necessity of tilting is eliminated by the use of a hollow iron cylinder which is lined with an inner sleeve of porcelain. The gap between the electrodes is inside the iron cylinder, which is actuated by a magnetic coil around the glass tube.—*Electrical World.*

The Wickman Screw Gauge.

The Wickman adjustable thread snap gauge claims to effectively and rapidly gauge screws, and is worthy of study inasmuch as the advantages claimed for it are numerous. Fig. 3 illustrates the gauge, which is supplied by MESSRS. ALFRED HERBERT, LTD., of Coventry, and which has been developed from the plain adjustable snap gauge. The anvils

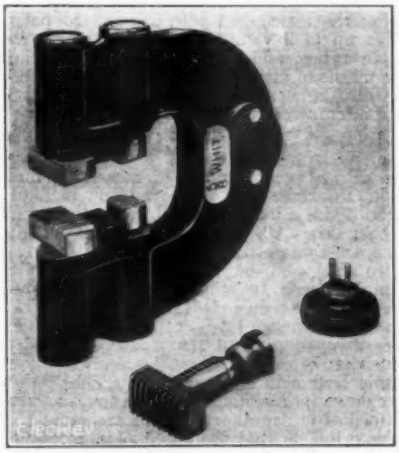


FIG. 3.—WICKMAN SCREW GAUGE.

supplied with the gauge are threaded according to the various pitches which it may be required to gauge, and the front set of anvils has what is known as a "full form" shape, viz., the anvils represent a perfect thread of the particular pitch

they are required to gauge. As diameters are adjustable, these anvils have only to be correct in form of thread and pitch. The second set of anvils is cleared on the major and core of the thread, so that they only test the effective diameter or flank of the thread to be gauged. This feature overcomes one of the chief faults of the ring gauge, viz., the passing of screws with threads which are too thin for mechanical strength. By adjusting these "no-go" effective anvils below standard size to some predetermined amount, it is possible to set the limit on the thinning, or decrease of effective diameter below which the "no-go" anvils will pass over the work, and so reject it. If the work also fails to pass the first set of anvils, the operator can hold the gauge up to the light, with the work between the anvils, and see exactly what element of the thread to be gauged is in error. With a weekly inspection of the gauges, there never need be an error, it is claimed, greater than .0002 between the set-up gauge and the hardened ground standard. The gauge is sealed by means of lead seals pressed into position by a special press which can be locked. This press indents the users' monogram in the lead seals, and it is impossible to remove it without detection. The adjusting screw is underneath the locking screw, which in turn is under the lead seal, so that no screw or pin is exposed, effectually preventing any possibility of tampering therewith.

An Opal Glass Gasfilled Lamp.

As has been the case with a great many more inventions, the gasfilled lamp has been badly abused, at any rate as regards its smaller sizes, by being employed without any sort of diffusing device to relieve the eye-straining glare. In there circumstances we are pleased to hear from THE EDISON SWAN ELECTRIC CO., LTD., of Ponders End, Mid-

FIG. 4.—THE "FULLOLITE" GASFILLED LAMP.

dlesex, that it has placed a lamp (fig. 4) on the market to remedy this rather serious fault. This lamp, called the "Fullolite," is made of opal glass, giving perfect diffusion of light. The surface of the globe is smooth, and the dust-collecting defects of sand-blasted or acid-treated glass do not appear. The new lamps are manufactured in all standard voltages and ratings up to 200 watts.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Home Lighting Economies.

Has not your correspondent "E. R." turned down Voltman's suggestion somewhat reproachfully?

I have had this system in successful operation in my house for at least five or six years, during which the only attention I have found necessary is the occasional topping-up of the 4-volt accumulator. I use 6-volt steering-pillar lamps, and my 60 ampere-hour cell is not only in circuit with the whole house lighting, but also with my heating circuit.

My use of the cell being practically continuous (for back hall and landing lights, which are, of course, only intended to render "darkness visible"), I find that I never require to use the change-over switch provided for cutting the cell in and out of charge.

In addition to operating small lights, as above, and for cupboards, &c., I also run my clock, and see no reason why I should not operate the bells, except that the wiring for them is imbedded in the plaster, and appears to be of inferior insulation. I have found the cell useful for a safety lamp on my iron circuit controlled by a d.p. switch, one pole on the power main and the other on the cell. This was the only apparent solution to repeated failures of shunted lamps, and some warning is essential with electric irons.

I have been careful to insert the cell and connections in the neutral wire, so that ordinarily they would not be subject

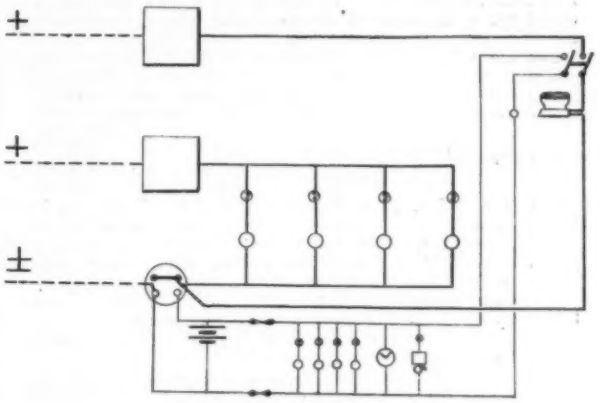


DIAGRAM OF CONNECTIONS.

to any potential difference much above earth, and in the unlikely event of rise of pressure on this otherwise neutral wire, the fuses on the cell connections would be blown before any weakness on them could let a dangerous current pass. The cell itself stands in the usual insulated tray, and is not subject to the open-circuit supply voltage, being permanently in the neutral wire.

W. H. R.

I was interested in "Voltman's" suggestion for the economical illumination of inaccessible places and dark recesses, but more particularly in "E.R.'s" comments in your issue of January 7th, with which I in part agree and in part disagree.

"Voltman's" suggestion is quite sound in principle if properly carried out. It is a scheme of which I have made use for several years now with success.

I will take "E. R.'s" points in the order in which they come. The argument that the flexible and miniature switches and lamp holders usually associated with 4- or 6-volt lamps are quite unsuitable for connection to a 230-volt circuit does not apply in most cases, as almost invariably one of the mains is at zero potential, or nearly so, in relation to earth, and it is naturally on this main that the cells are put in series with the full voltage lamps so as to be on charge whenever a big lamp is in use. This is necessarily the case where a three-wire system of distribution is used, as is usual for d.c. work. Under these circumstances the low-voltage circuit will *never* be alive to the full pressure of the supply; as "E. R." states, the only pressure existing on or between any of the wires will be a matter of a few volts.

It is true that if accumulator cells of the acid type are used for this purpose, the system is not safe, unless under constant supervision, as there would be some small danger, as "E. R." states, of the cells going dry. This danger, however, is one that would not often occur, as it takes a long time for cells to go dry. A more obvious danger is that occurring from corroded terminals. If the circuit through the cells gets broken by corrosion or otherwise, then there is danger of an arc occurring and a fire being started, especially if the cells are of celluloid, and no doubt fires have been caused in this way.

In my own arrangement I make use of alkaline cells in which the connections are solid steel bolted, and there is no possibility whatever of the connection being broken if correctly carried out. There is also very much less topping up required with these cells, especially if the small lights take about as much current as the big lights put in.

I find that the system on these lines is quite automatic in action, the voltage of the cells rising just at the time when it is wanted to light the small lamps. On my system the small lamps are in pantries, lavatories, small bedrooms, and bed-reading lamps, and are mainly required after the full-voltage lamps have been on for some little time. The system can be, and has been absolutely left for two months or more without any trouble of the kind that "E. R." mentions. Occasional replacement of small lamps is required, as would be expected.

Regarding also the idea of running lamps in series, I may say that I have in addition a system of running five 50-volt, 10-watt lamps in series for lighting landings, passages, and hall, which is also very satisfactory.

E. Fowler Clark.

Derby.
January 17th, 1921.

Shop Displays.

I have been interested in the correspondence of Mr. Marshall Carr, "Retailer," and others, and would suggest that instead of asking why things are not done, they should ask themselves: "What are they doing?" and whether they are not in a large measure responsible for the present state of affairs?

The E.C.A. has done, and is doing, good work, and could do more if every contractor was loyal to the Association; but its efforts are crippled by the outside contractor, who, instead of joining with others in an association, prefers to do as he likes.

The trade unions have a nasty name for this class of man. I suggest that instead of writing futile letters they should join the nearest branch of the Contractors' Association. Their enthusiasm and assistance will be welcomed.

One Who Knows.

January 12th, 1921.

I note that Mr. Tate, the secretary of the N.F.E.A., has "had his attention drawn" to my previous letter in your valuable columns. The prominence given to this letter by you has brought me numerous letters, all of which agree with my views contained therein.

I do not propose to follow Mr. Tate's example in mud throwing, or to take up your space unnecessarily.

My so-called personal grievances are, it is quite evident, general grievances, and what Mr. Tate is satisfied to term "vague charges" are in fact clear, inasmuch as I say distinctly: The N.F.E.A. as at present constituted has proved itself wholly incapable of dealing with problems all-important to the majority of its members, whilst pandering and legislating to the benefit of a possible minority, which is made up of those who formulate the legislature, pass it in committee, and push it through.

I repudiate Mr. Tate's statement that I or my firm thanked the solicitors for their so-called help, and it must be evident to your readers that the matter in question, viz.: Supply company's charges to consumers for service mains, cannot be of any financial interest to us, and only in endeavouring to protect the public are we concerned. With all deference we submitted this to the E.C.A., which refused to take it up, and advised us to deal direct with its solicitors; this we did, and paid their costs ourselves, and at the same time put numerous clients in communication, all of whom, including ourselves, got no satisfaction. Perhaps Mr. Tate will obtain the letters of thanks from our clients and allow you to publish them.

The last paragraph of Mr. Tate's letter is wholly misleading; suffice it to say that the management of funds received by the N.F.E.A. under the cable makers' agreement is on a par with the unbusiness-like methods they adopt.

The subsidy fund contribution has not been paid, as this is our only means of protest.

In conclusion, not being hypocrites, we cannot practise loyalty as suggested by Mr. Tate to an Association which is beneficial only to those who run it, but suggest to Mr. Tate that the first step towards loyalty would be from the Association to its members.

Watson Marsh & Co. (Hampstead), Ltd.,
M. COHEN,
Managing Director.

Hampstead.
January 17th, 1921.

Cost of Living in Tanganyika Territory.

Could you possibly give me any idea of the general conditions prevailing in Tanganyika Territory, Africa, in the central station line, also any information regarding cost of living, &c.? If you happen to have any information regarding those things I should be obliged for it.

Q.

January 12th, 1921.

[Correspondence on this subject is invited.—EDS. ELEC. REV.]

The Life of Metallic-filament Lamps.

As your correspondent "Dudlux" remarks, it is high time that a protest was raised against the great inferiority of the metal-filament lamps at present being supplied to the British market. All the various makes seem to be far below their pre-war or even "wartime" quality, as regards both life and candle power.

Our experience during the last few months is that fully 20 per cent. of the "vacuum type" fail prematurely, and quite 40 per cent. of the "gasfilled" break down almost immediately. Although the makers are generous in replacing these defective lamps, there is no doubt that the bad quality of electric lamps is doing the electrical world much harm, owing to annoyance caused to consumers and consequent loss of faith in electricity as an illuminant.

During the war there was perhaps a legitimate excuse for the lamp makers, as raw material of the correct kind was difficult to obtain, but surely two years of peace should be sufficient for them to put their house in order.

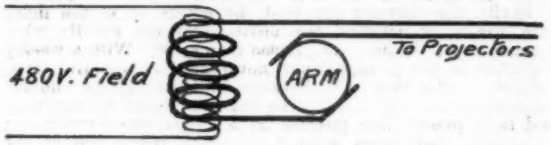
If the lamp makers were to devote more money and attention to perfecting their products, instead of to huge advertising schemes, prices would fall, as the cost of replacing the present number of defective lamps must be enormous.

Norman Aish.

Bournemouth.
January 15th, 1921.

A Generator Problem.

Referring to Mr. Robinson's and Mr. Besley's letters of the 8th inst. on the above subject, probably the following sketch will be of some assistance.



This is a 4-pole machine, and has no interpole coils, so I should not say that the compound is actually the interpole winding.

Wireman.

January 15th, 1921.

A Curious Phenomenon.

The correspondence *re* "A Curious Phenomenon" brings to mind an incident which happened during the early days of the war.

I was then a wireless operator stationed at Rosyth Naval Base; our wireless room was lighted by means of acetylene gas. I noticed that whenever the key was depressed the flame grew smaller, and that as long as the key was depressed the flame remained small. The spark was uncovered, and in the same room as the gas light.

There may be some explanation to be found in the fact that electric waves and light waves travel at the same speed.

Jacraigie.

Huddersfield.
January 15th, 1921.

Underground Tie Lines.

I notice that in the discussion at Glasgow on Mr. Woodhouse's paper Mr. N. C. Bridge is reported as having said that he thought there was no advantage to be gained in power transfer lines, because, first, the line might not be used except once in a way for a period of a year, and secondly, the amount of generating plant necessary for the passage of the energy through the tie line must be kept available at both stations.

It is true that for both stations to get the full advantage of the tie line the obligation must be reciprocatory, but this does not necessarily involve that the smaller station should always have the requisite amount of power lying idle, because it does not follow that the time of the year at which the other station requires the power will necessarily coincide with the maximum demand on the smaller station.

The point, however, which I would like to emphasise is that if tie lines of this nature are being considered, and if the standing charge on these tie lines is worked out in terms of so much per unit, the figure necessarily comes very high, because the total number of units passed over the tie line is so low. If, however, the standing charge on the tie line is divided by the total number of units supplied by the generating station, and not by those supplied over the tie line, a comparison is then obtained in terms of per unit with the total costs of the said generating station; and without going now into details, I believe, for example, that it will be found that on a tie line 30 miles long, and capable of transmitting 30 per cent. of the output of the generating station, or, say, 30,000 kVA, the cost of the tie line would not add more than 3 per cent. to the cost of the unit as turned out by the generating station.

If this be so—and I believe it is capable of demonstration—then surely that is a much smaller handicap on the generating station than even the normal fluctuation in the price of coal or wages, and may be looked upon as of the nature of an insurance, in return for which one may save the whole of the generating plant from being seriously overloaded for a period, it may be, of some months, resulting no doubt in a considerable shortening of its ultimate life; or, alternatively, one may take on 3 per cent. additional consumers (and thus pay for the insurance) without appreciably diminishing the 30,000 kVA required to be available. What one would really do would, of course, be to put in the tie line for 33,000 kVA. so as to get the 30,000 kVA after the 3,000 kVA for the new consumers, had been deducted.

Where transformers of the suitable pressure already exist at both stations, the supply and running of the cables should surely be a work involving *greatly* shorter periods of time to carry out than the putting down of new generating plant, and affording great opportunities for the utilisation of rough labour, which in the present state of the country's finances would seem to be a good investment.

A. M. Taylor,
Hon. Major.

Birmingham.
January 14th, 1921.

Freemasons' Lodges for Engineers, London Area.

Having noted Mr. V. Delebecque's remarks concerning Freemasons' Lodges for engineers, I should be pleased to hear if there are any such lodges in London.

I shall be pleased if all those interested will communicate with me.

E. Boulter.

Harrow-on-the-Hill.
January 17th, 1921.

[In London the Telephone and Kelvin Lodges are restricted to electrical engineers, and in Middlesex the Electric Lodge, meeting at Hampton Court, is mainly electrical. Other London engineering Lodges are the Vulcan, Archimedean, Hardware, and Junior Engineers.—EDS. ELEC. REV.]

[Many letters have been received too late for insertion.—EDS. ELEC. REV.]

LEGAL.

THEFT OF LAMPS.

THOMAS HARRISON, a labourer, was charged at Rotherham recently with having stolen electric lamps valued at £2 10s. from Messrs. Steel, Peech & Tozer, Ltd., and Messrs. W. Cooke & Co., Ltd. It was stated that the accused was employed by a contractor carrying out work on the Templeboro' extensions. The lamps had been taken from the stores of the firms concerned, access having been obtained by means of skeleton keys. Previous convictions were proved, and the prisoner was sentenced by the Bench to three months' imprisonment with hard labour.

BEDSER *v.* EVANS.

AT Bishop's Stortford, an action was brought by Mr. P. H. Bedser, electrical engineer, to recover from Mr. E. A. Evans, rope maker, the sum of £76 19s. 2d. for electrical work which had been executed and materials supplied. According to a report in the local Press, counsel stated that in August last the defendant, who had premises next door to the kinema, of which Mr. E. E. Smith was proprietor, was desirous of installing electric light and taking the power from the engine at the kinema. Plaintiff told the defendant that the cost would be approximately from £70 to £80, and particularly if Mr. Smith's employé helped with the wiring. It was important for the order to be accepted that it should have been given at once, but owing to the cost of materials the defendant did not proceed further with the matter at that time. When the plaintiff came to do the work he charged fair and reasonable prices, and his original bill included an amount which he thought Mr. Smith would expect for allowing his man to assist in the work for the defendant; but he understood Mr. Smith said that he did not want anything out of it. An amended bill was sent in in April for £125; the defendant paid £50 on account, and it was for the balance that the plaintiff now sued. The case was heard at length, a good deal of technical evidence being given as to the installation of the electric light and the price of the materials which were used, and subsequently a private consultation between the parties took place. A settlement was arrived at, with judgment for the plaintiff for £50, in addition to the sum already paid into Court, such amount to include costs.

APPRENTICE'S APPEAL DISMISSED.

THE Court of Session, Edinburgh, on January 15th, disposed of a stated case in an arbitration under the Workmen's Compensation Act between an apprentice electrician of Shotts and the Baton Colliery Co., Ltd., Shotts. In the lower Court the Sheriff refused to grant the lad compensation because it was held that severe burns which he received on his hands through contact with a live wire were incurred while doing work which was outside the sphere of his employment. The lad appealed against this finding. The Court of Session affirmed the decision of the lower Court, holding that he had added a peril to those imposed upon him by his contract of service, and dismissed the appeal.

BUSINESS NOTES.

Company Liquidation.—HIGH TEMPERATURE GENERATORS, LTD.—Winding-up voluntarily. Liquidator, Mr. F. Morse, 1 and 2, Great Winchester Street, E.C.

Trade Announcements.—THE SUNDERLAND FORGE AND ENGINEERING CO., LTD., announces that the new address of its Belfast branch is Sydenham Road Works (off Queen's Road), Belfast. Telephone: No. 1036. Telegrams: "Marr," Belfast.

MESSRS. HOGAN & WARDROP, of 2, Gresham Buildings, Basinghall Street, E.C., the London and District representatives of the Midland Electric Manufacturing Co., Ltd., inform us that their agency has been extended to cover the whole of the South-Eastern Coast from the Wash, and the Southern Coast to Chichester.

MESSRS. WALLIS-JONES & DENT, consulting engineers (Mr. R. J. Wallis Jones, M.Inst.C.E., M.I.E.E.), have removed to their new offices at Adams House, 23, Old Queen Street, Westminster, London, S.W. 1. Telephone: Victoria 8070. Telegrams: "Alteration," Victoria, London.

On and after the 31st inst. the London offices of the PARSONS MARINE STEAM TURBINE CO., LTD., and C. A. PARSONS & CO., LTD., will be at 56, Victoria Street, S.W. 1.

Lead.—MESSRS. JAMES FORSTER & CO. state that the following particulars of lead supplies for 1920 disclose how much we have been dependent during the year on Government stock, and the abnormal supply of chemical scrap lead from dismantled war plant:—

BOARD OF TRADE RETURNS.

	Imports. Tons.	Exports. Tons.	Left for home absorption. Tons.	
January	5,888	4,679	1,209	
February	8,598	5,611	2,987	
March	13,600	7,527	6,073	
April	10,436	4,910	5,526	
May	14,568	3,317	11,251	
June	9,343	3,680	5,663	First half 32,709
July	12,587	3,960	8,627	
August	14,767	5,107	9,660	
September... ...	16,872	8,866	8,006	
October	16,128	7,083	9,045	
November	17,279	3,934	13,345	
December	22,784	3,099	19,685	Second half 68,368
	162,850	61,773	101,077	
January 1st.—Stocks in Government stores		54,975		
December 31st.—Stocks in Government and public warehouses ...		19,045	35,930	
Total for home absorption ...			137,007	

The imports from Australia amounted to 59,987 tons, or 37 per cent. of our total imports, and owing to the strike at Broken Hill were entirely from stock. There is now no stock in Australia therefore for the time being this source of supply is cut off. From Spain we received 58,149 tons. An additional source of supply last year, which is also exhausted, was obtained from the dismantling of chemical plant erected by the Government during the war, which accounted for several thousands of tons.

MESSRS. G. CAWSON & CO. report:—Lead is coming forward very slowly, and there is very little lead on the market except a few second-hand parcels. It rather looks as if this position may be maintained, as there is very little lead afloat for this country. Were it not for the general slackness of trade the position would seem to warrant an improvement in price. Consumers have been making some small purchases to cover actual requirements, but are not operating by any means freely. Should the financial position become easier, and trade be thereby encouraged, this position may perhaps change.

Bankruptcy Annulled.—At the Leeds Bankruptcy Court, on January 11th, Oswald Carr, formerly in business as an electrician, at Oak Works, Headingley, Leeds, applied for the annulment of his bankruptcy, which took place in 1911, he having paid his debts in full. Mr. W. H. Clark, solicitor, on behalf of Carr, stated that debtor had obtained work on the West Coast of Africa, and had been able to make sufficient money to liquidate his debts. He was now on holiday in this country. Mr. J. W. Gillespie (Registrar) granted the application, and commented upon the debtor's creditable action.

Catalogues and Lists.—LAMLOK, LTD., 36, Rusthall Avenue, Chiswick, W. 4.—A blotter advertising "Lamlok" electric lamp locking rings, lampholders, and adjustable cord grips.

THE AQUA ELECTRIC HEATER CO., 168, Regent Street, W. 1.—A leaflet illustrating, by means of a cut-away drawing, the construction of the "Aqua" instantaneous electric water-heater, delivering hot or cold water from the same tap.

THE HART ACCUMULATOR CO., LTD., Marshgate Lane, Stratford, E. 15.—Leaflet illustrating and describing "M-E" type ignition batteries; priced. Also a folder giving the various sizes of "Hart" batteries suitable for replacing the existing batteries on American cars imported into this country.

THE ELECTRIC CONSTRUCTION CO., LTD., Dashwood House, 9, New Broad Street, E.C. 2. Two well-produced booklets dealing with the "E.C.C." small house lighting sets. One is an illustrated specification of the plant, giving prices; the other contains a number of hints on starting and running, with diagrams and illustrations.

THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C. 4.—A showcard (19 in. × 4½ in.) advertising the "Magnet" pedestal electric heater, and depicting a lady in an evening gown bathed in the heater's cheerful rays.

L. G. HAWKINS & CO., 116, Charing Cross Road, W.C. 2.—Booklet No. 665, dealing with "Universal" electric grills and portable ranges, and giving a large number of recipes which may be prepared with these appliances.

THE EDISON SWAN ELECTRIC CO., LTD., Ponders End, Middlesex.—Pages 101, 102, 107, 108, 111, 112, 113, 114, 115 and 116 of new instruments list, illustrating and describing moving coil switchboard type instruments, including voltmeters, ammeters and horse-power meters.

INTERNATIONAL FILM TRADERS (ALFRED LYONS & CO., LTD.), 5, Denmark Street, Charing Cross Road, W.C 2.—Seven illustrated and priced leaflets dealing with kinematograph outfits, electrical instruments, motors, carbons, switches, fuses and other kinema accessories.

GENT & CO., LTD., Faraday Works, Leicester.—Postcard (No. 44), dealing with iron-cased electric bells of various sizes for both a.c. and d.c. Priced.

ALFRED HERBERT, LTD., Coventry.—A souvenir brochure giving a number of views of the company's works. The illustrations are very clear, and disclose a wide range of operations.

C. A. VANDERVELL & CO., LTD., Acton, W. 3.—Folder "L." A well-illustrated price list of various types of electric horn for use on automobiles.

J. & W. B. SMITH, LTD., 15-23, Farringdon Road, E.C. 1.—Catalogue No. 143. An excellent example of publicity matter consisting of 223 pages of illustrations of artistic electrical fittings and glassware, including chandeliers, pendants, statuettes, table standards, crystal fittings, bowl fittings, Holophane reflectors, ships' fittings, &c.

E. P. ALLAM & CO., 107-109, Gray's Inn Road, W.C. 1.—Monthly Stock List, No. 5, of d.c. electric motors for sale or hire.

THE LONDON TELEPHONE (NEW SYSTEM) CO., LTD., Donington House, Norfolk Street, Strand, W.C. 2.—A folder illustrating an interconnecting 'phone system, and embodying an application-card for a demonstration.

THE LANSTON MONOTYPE CORPORATION, LTD., 43 and 44, Fetter Lane, E.C. 4.—"The Monotype Recorder," containing advertisements of printing machines, &c., sold by the company as well as two or three interesting notes on the "monotype" and some users.

AUSTIN WALTERS & SON, Gaythorn Electric Works, Little Peter Street, Manchester.—A profusely illustrated leaflet describing tandem resistances for kinematograph work and theatre light "dimmers."

Calendars. — MESSRS. SMITH & CO., electrical and mechanical engineers, 17, West Tower Street, Carlisle, have issued a calendar bearing a picture of an "old salt" telling "A Likely Story."

MESSRS. C. PURDEN, LTD., mill and factory furnishers, Lancaster Street, Birmingham, have sent us a charming three-quarter length picture of a lady. The monthly date-slips are printed in bold figures.

In sending us a calendar adorned with a handsome picture of the "Incoming Tide," reminiscent of St. Bees, MESSRS. FREDK. HODGSON & CO., LTD., quote their motto:—"Satisfied clients by thorough work make lasting reputation."

MESSRS. J. CULKIN & CO., electrical engineers, 1B, Skinner Lane, Leeds, have forwarded a calendar bearing a picture entitled "The Path of Dreams," portraying a lady seated upon a terrace gazing pensively at the sea in which the "sun's declining rays" are reflected.

MR JOHN D. MACKENZIE, 155A, St. Vincent Street, Glasgow, has sent us a calendar with bold-figured monthly sheets. Against each date is a small space for memoranda.

MESSRS. W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., inform us they have a number of refills left suitable for use in the calendar which they issued last year, and if any of their customers have retained the last year's calendar and would care for a refill, they will be pleased to forward one on request.

For Sale. — MESSRS. L. FARMER & SONS inform us that the auction sale on February 8th and following days, of electrical equipment and stores lying at Woolwich Arsenal and Dockyard will, for the convenience of purchasers, be held at the Commercial Sale Rooms, 30, Mincing Lane, E.C.

By direction of the Disposal Board, Ministry of Munitions, MESSRS. G. N. NIXON & CO. will sell by auction, on February 1st and following days, at the R.A.O. Depôts, Park Lane, Aintree, and Burscough, near Liverpool, a quantity of electrical material and equipment, comprising motor-generator sets, electric lighting plant, batteries, switchboards, &c.; Warrington Corporation Electricity Department has for disposal five Babcock & Wilcox water-tube boilers, coal bunkers, delivery shoots and coal conveyer; West Bromwich Corporation has for disposal two Babcock & Wilcox boilers with Foster superheaters, &c., two Weir feed pumps; the plant and machinery section of the Disposal Board has for sale by public tender, 150,000 inert cells, by Siemens & Halske, lying at Wood Lane, Shepherd's Bush, and Richborough; MESSRS. GEERING & COLYER have been instructed by the Disposal Board to offer by auction, on February 3rd and 4th, at Earl's Court Exhibition, and at the C.S.D. No. 5, Wood Lane, Shepherd's Bush, a quantity of machine tools, railway material and electrical equipment. For particulars see our advertisement pages to-day.

Proposed New Works Department.—It is announced that the Treasury has been asked to sanction the creation of a works department at the Office of Works. For a start it is proposed to spend £28,000 on plant and £4,000 a year on additional staff. The manager is to receive £900 a year plus bonus.—*The Builder.*

Socials.—The officials and members of the Mains Department of the Southport Corporation Electricity Department held their annual social gathering on January 12th. Dinner was followed by an excellent musical and humorous programme. The proceedings throughout were of a highly enjoyable character.

On Friday evening, the 7th inst., the London Office staff of Messrs. Boving & Co., Ltd., and Electro-Metals, Ltd., together with their friends, were entertained to dinner at the Holborn Restaurant by their directors, this being followed by a musical programme and dancing.

On January 15th the staff of the Foster Engineering Co., Ltd., held a fancy-dress dance and social at Wimbledon. Over 100 guests were present, and the costumes were original and varied to a degree. The dance music was ably supplied by Mr. C. B. Jones (piano) and Mrs. Moxan (violin). A waltz selection was given by the "Wimbledon Juvenile Orchestra," under the able direction of Mrs. Moxan. Mr. "Dick" Williams admirably filled the post of M.C. during the evening. The party broke up at 11.45, with the singing of "Auld Lang Syne" and the National Anthem.

On January 5th the second of a series of socials was held in the Bristol showrooms of the Edison Swan Electric Co., Ltd., under the chairmanship of Mr. Fifield. A varied programme of songs, dialogues, recitations, and a conjuring display made the evening a complete success.

Book Notices.—"Lockwood's Builder's, Architect's, Contractor's and Engineer's Price Book for 1921." (429 pp. and supplement, 284 pp.) London: Crosby Lockwood & Son. Price 7s. 6d. net.—The preface to the present edition of this work includes a set of diagrams showing the rise in the costs of wages and materials since 1914. Among the new features is the form of building contract and schedule of conditions issued by the Institute of British Architects, and the supplement consisting of the London Building Act, 1894, and amending Acts has been brought up to date by notes on recent decisions in the Courts. The general index has been transferred to the front of the volume for ease of reference.

"*Journal* of the Institution of Electrical Engineers." Vol. LVIII, No. 295, September, 1920; and index to Vol. LVIII. London: E. & F. N. Spon, Ltd. Price 10s. 6d.—This issue contains the following papers: "Thermal Efficiency of the Generation and Use of Gas and Electricity," by Sir Dugald Clerk; "Permanent Magnets in Theory and Practice," by Mr. S. Evershed; "Electric Railway Contact Systems," by Sir P. Dawson; "Application of the Electric Locomotive to Main Line Traction on Railways," by Lt.-Col. H. E. O'Brien; "Contract Prices," by Capt. W. P. Digby; and "Use of Vacuum Tubes for Wireless Transmission and Reception," by Mr. J. Scott Taggart.

"The Inventors' Annual Review," a record of progress and achievements (22 pp.). London: The Inventors' Union. Price 1s. net.—This new publication covers a wide field embracing every department of invention and discovery. The Severn barrage scheme is dealt with at some length, and the aims and objects of the Inventors' Union are set out. An article advocating an "All-Empire" scheme of patent protection, also appears.

"The Callender Kay Poles for Power Transmission Lines" (78 pp.). London: Callender's Cable and Construction Co., Ltd. Price 5s.—This is a well illustrated brochure describing the design, construction, and erection of an improved means of supporting aerial transmission lines and distributing their weight. The towers were introduced in 1912, but the war retarded their development. The illustrations are very clear and instructive. A large photographic reproduction is given of four spans of a line erected for the South Wales E.P.D. Co. between some of the South Wales hills.

"*The Electrical Engineer's Diary*, 1921." Thirteenth edition. London: S. Davis & Co. Price 10s. 6d. The additions to the latest issue of this invaluable work include articles on mercury arc rectifiers, a comparison of old and new cable standards, fault localisation, insulation tests, vulcanised rubber cables, centrifugal fans, portable electric tools, automatic telephone systems, electric hot-plate efficiencies, vacuum cleaners, and extracts from the I.E.E. regulations for the electrical equipment of ships. Perhaps the most important innovation is the introduction of a section dealing with electric vehicles and trucks, in which are given comparisons of various types, costs of operation, descriptions of accumulators, and a great amount of other information. We are interested to note that the objectionable term, "half-watt," in connection with lighting has given place to the more truthful adjective, "gasfilled."

For the convenience of those who wish to carry the Diary about with them an edition in limp covers has been prepared from which the ruled memoranda pages have been omitted. An interesting point about this publication is that, although it has increased twelvefold in size since its first appearance, the present price is only four times that of the original.

"Factory Administration and Costs Accounts." By E. T. Elbourne. Pp. xx + 811. London: Longmans, Green & Co. Price 45s. net.

"The Theory of Direct-Current Dynamos and Motors." By J. Case. Pp. xiii + 196; 120 figs. Cambridge: W. Heffer & Sons, Ltd. Price 15s. net.

"Lubricating and Allied Oils." By E. A. Evans. Pp. xv + 128, 25 illustrations. London: Chapman & Hall. Price 9s. 6d. net.

Copper Prices.—MESSRS. F. SMITH & CO. report January 18th:—Electrolytic bars, sheets, wire rods and H.C. wire, no change.

MESSRS. JAMES & SHAKESPEARE report January 19th:—Copper bars (best selected), sheets and rods, £127, £3 decrease; English pig lead, £25, 20s. decrease on last week's prices.

American Inventors and the Peace Treaty.—American inventors, it is said, are losing their patent rights abroad through the failure of the United States to ratify the Peace Treaty.—*The Times.*

A Transformation Scene.—Recently the Bute Saw Mills, Luton, were changed over from *batswing gas burners* to electric lighting, with "Masdalux" intensive reflectors and Mazda gas-filled lamps, giving an illumination of six foot-candles with an expenditure of 0·65 to 0·7 watt per square foot. We are not surprised to learn that this drastic change has exerted a beneficial influence on the comfort and output of the workers, though we were astonished to hear of the survival of the open gas-flame in a large workshop, containing moving machinery, so far into the 20th century. The Illuminating Engineers' Department of the British Thomson-Houston Co. was responsible for the scheme.

Electricity Supply Rifle League.—The results of the final (December) matches were as follows:—Shoreditch, 573—City Co., 565; City Co., 574—St. James's, 553; Metropolitan, 583—Central, 561; Central, 562—St. James's, 546; Metropolitan, 575—St. James's, 518. Shoreditch are the winners of the shield and medals for 1920, with a total of 26 points; the Metropolitan team were the "runners up," with 24. Hampstead and Poplar had to drop out early in the season owing to their inability to raise teams.

Taxation of Vehicles.—A contributor to *Motor Transport* says that electric vehicle owners can congratulate themselves on the fact that the weight of these vehicles taken into consideration in the new vehicle taxation scheme is the weight without batteries. In this way the chassis weight of most electrics is about the same as that of a petrol or a steam vehicle of equal carrying capacity. The tax will, therefore, fall practically equally on each. Taking the figures for a two-ton electric chassis, the average weight appears to be just over the two-ton limit, and, therefore, the tax will be £25; if the weight of the battery were included, the amount payable would be £28. By using strong but lighter materials in both chassis and body, makers may be able to keep their two-ton vehicles within the limits of the £21 tax.

B.T.H. Dinner.—The foremen of the switchgear works of the BRITISH THOMSON-HOUSTON CO., LTD., held their first dinner in the Duke's Room at the Holborn Restaurant on New Year's night, when a company of about 50, including a few members of the office staff, sat down to an excellent repast. The chair was taken by the manager, Capt. C. R. Acklom, R.N., C.B., C.B.E., supported by Mr. A. Cresswell as vice-chairman. Mr. H. Trencham (chief engineer), in proposing "The Chairman," complimented Capt. Acklom (who has been but a short time at Willesden) on the thoroughly capable manner in which he had assumed command. The manager suitably replied. During the evening a most enjoyable entertainment was given, under the direction of Mr. Albert Nelson, who is a member of the staff of the Willesden works. A feature of the programme was the fine singing of Mr. Frederick Shaw, of the Royal Opera, Covent Garden, whose exquisite tenor voice was greatly appreciated by all.

Motor Cycle Lighting.—In the recent London-Exeter 24-hours' continuous run reliability trials for motor cycles, the only 2¼-h.p. machine to receive a Gold Medal was a Metro-Tyler, driven by J. S. Bennett. This motor-cycle was in one respect unique, *i.e.*, unlike many other competing cycles, it depended for lighting its front and rear lamps entirely upon a combined magneto and lighting set, which was a B.T.H. "Sparklight," and which for 15 hours on the outward, and for 5 hours on the return journey, gave perfect lighting, the accumulators being as fully charged at the end as at the beginning of the journey. The B.T.H. "Sparklight" set uses the idle half of the voltage wave generated in the low-pressure winding of a single cylinder magneto—and usually wasted—for charging the battery or supplying the lights. The above performance speaks well for the reliability of these sets.

Industrial Questions.—On Wednesday evening, at a meeting of the Industrial League and Council, held at the Caxton Hall, Sir George Paish lectured on "World Finance." Next Wednesday, 26th inst., "Unemployment: the Best Means of Dealing With It," will be the subject of an address by Mr. E. W. Petter. The lectures, under the auspices of the Industrial League, will continue to be held regularly each Wednesday evening at Caxton Hall, until March 30th, and among the subjects to be dealt with are:—"Some Factors in Present-day Industry," by Prof. A. W. Kirkaldy, M.A.; "Payment by Results," Mr. E. J. P. Benn; "Control of Industry," Mr. H. H. Elvin; "Health in Industry," Dr. E. Halford Ross; "Scientific Management as a Factor in Production," Mr. A. R. Stelling; "The Ex-Service Man and his Reinstatement in Industry," Mr. C. Latham; "Some Obligations of Industry to Labour," Mr. T. W. Casey, M.P.; "Works Committees and their Functions," Mr. Robert Young, M.P.; "Industry and its Relation to Finance," Mr. H. G. Williams, M.Sc., &c.

South Wales Wages Reduction.—The South Wales copper workers have agreed, says the *Evening News*, to accept a 5 per cent. reduction in wages. It was stated that unless the men accepted the proposal the works would have to be closed down.

Metal Prices, 1920.—MESSRS. THE METAL INFORMATION BUREAU, 7, East India Avenue, E.C. 3, have sent us a copy of their "Metal Chart" for 1920, which shows very clearly the official day-by-day average prices of copper, tin, spelter and lead for the past 12 months. The remarkable fluctuations in tin and copper make the chart of more than ordinary interest and utility.

Dangerous Processes.—The Home Secretary has certified the following processes incidental to the manufacture of india-rubber, and of india-rubber goods, to be dangerous:—(*a*) Vulcanising by means of the process known as the cold cure process; (*b*) any other process involving the use of carbon bisulphide, sulphur chloride, carbon-chlorine compounds, or benzol; (*c*) any process involving the use of lead or lead compounds.—*The Times.*

The Shut-down at Ilford.—The following official statement has been issued by the Electrical Power Engineers' Association:—

On December 11th the National Joint Board officially requested the Ministry of Labour to bring pressure on those undertakings which had refused to accept the Schedule and Conditions, and the E.P.E.A. agreed with the Ministry to deal with these undertakings in groups according to the District Areas.

In District Area No. 10 (Greater London) there were 53 undertakings, of which only four were defaulting—Hackney, Hornsey, Finchley, and Ilford. A meeting of representatives of these four undertakings and the E.P.E.A. was held in December, and the undertakings were given 10 days in which to decide to pay. Hackney, Hornsey, and Finchley complied, but Ilford agreed to accept the Schedule and Conditions in their entirety for six months only, and also circularised other Councils to support it in repudiating the Schedule at the end of six months.

The E.P.E.A. notified the Ministry of Labour that this qualified agreement would not be accepted, as the Association would not give preferential terms to undertakings merely because they held out to the end.

The Ilford Councillors explained to the Ministry that their resolution was not intended to mean what it said. They said that the intention of the Council was to accept the Schedule, and at the end of six months they intended to review the situation, but the Schedule would continue to be paid at the end of the six months unless they passed a resolution to cancel it.

The E.P.E.A. intimated to the Ministry that if the resolution intimating acceptance had no time-limit incorporated in it, so that it was not more favourable to Ilford than to the other undertakings which had accepted, they would exempt Ilford from the strike, and the Ilford councillors promised the Ministry to call a special meeting the next week to alter the wording of the offending resolution, and to make it say what they had all along intended it to say.

At the next Ilford Council meeting, however, by 9 votes to 7, the previous wording was confirmed, and the E.P.E.A. gave its final warning—24 hours' notice.

It seems that Ilford Council had just previously only partly paid a recommendation of the Industrial Council to its workmen, and had refused to arbitrate on the claim of the clerical staff for the Civil Service Award. These other workers were, therefore, anxious to press their claims at the same time as the E.P.E.A. In the case of Ilford, the E.P.E.A. claims are a very small part of the price which the Council will have to pay now to get a settlement, and other undertakings will probably think very seriously before driving the E.P.E.A. members into a strike.

It is reported that the Ilford District Council remains obdurate; on January 17th it was even proposed to dismiss all employés of the Council who were on strike, and to fill their places, giving a pledge that those engaged should be retained in service so long as they proved themselves competent. But Sir David Shackleton, on behalf of the Ministry of Labour, induced the Council to defer decision, and to send a deputation to interview Dr. Macnamara. It will not be forgotten that the Southampton Town Council pledged its honour to retain in employment members of the E.P.E.A. who enabled it to carry on supply during a strike last year, and within a few days it shamelessly broke its pledge, to its lasting dishonour. What value will any honest man, then, attach to the pledge of a local authority?

It appears that the strike embraces not only the technical staff of the electricity works, but also the administrative and clerical staff of the Council and the non-trading manual workers; these three parties have joined hands to enforce the adoption of the awards of three distinct Whitley Councils, which have been generally accepted by other local authorities. Ilford Urban District Council is clearly "recalcitrant."

An Imperial Patent System.—The unfair exploitation of inventors was the subject of discussion at the first meeting of the recently-incorporated Institute of Patentees, held on January 12th. Sir Harry S. Foster, the president, said that one of the objects of the Institute was to persuade the various Legislatures within the Empire to adopt a system of Imperial Letters Patent. The present necessity of taking out a separate patent in each of the Dominions involved great expense, and in some cases great hardship on the inventor.—*Morning Post.*

Electricity Supply Wages Award.—According to the *Daily Herald*, the National Joint Industrial Council for the Electricity Supply Industry has agreed to put in operation the award for No. 10 Area, which was recently accepted by a ballot vote of the workpeople concerned. The award will give increases ranging from 3s. to 12s. 3d. per week, and it is to be retrospective, to September 1st, 1920. The National Council, while agreeing to put the award in operation, states that it does not agree with the principle involved. An application has been made to No. 9 Area Council for similar rates to those awarded by No. 10 Area Council, and was to be considered in London on Tuesday last.

New Commercial Agreement between Canada and France.—Canada has concluded a commercial agreement with France under which a minimum Canadian Customs tariff will be put into effect in exchange for a minimum French tariff on almost the whole list of articles included in the last commercial treaty with an extensive list of articles not previously included. The agreement also provides for a fixed percentage tariff on certain other articles, some of which were included in the last Convention at minimum rates. The agreement remains in force until a more permanent agreement is negotiated and is subject to cancellation at four months' notice.—*Reuter's Trade Service* (Ottawa).

Selling Benjamin Industrial Illumination. — The Benjamin Electric, Ltd., is conducting a well-planned advertising campaign, which is designed to raise the standard of industrial illumination throughout the country, by bringing home to the works owner, the architect, and the consulting engineer, in a convincing manner, the necessity of correct practice, and its importance as a factor in increasing production. A striking series of full-page advertisements has been prepared, which does not include illustrations of the many types of fittings that the Benjamin Electric, Ltd., manufactures; these advertisements are designed to sell "better illumination," rather than any particular type of reflector, and will appear in the Press of the following industries, quite apart from the general advertising in the electrical trade papers:—Mechanical engineering works, iron and steel foundries, paper mills, shoe and leather factories, textile mills, shipbuilding and shipping. In addition to these Press advertisements, over 52,000 letters (enclosing reprints of the advertisements) and folders are to be distributed through the post to owners of works and factories in all industries, and also to consulting engineers, architects, &c. Special letters and printed matter are being sent to those concerned with the sale and installation of Benjamin reflectors, including electrical contractors throughout the country, and the sales engineers on the staffs of the wholesale distributing firms. It is considered that the campaign will form one of the most effective sales helps to the dealer and contractor yet launched by any manufacturer. The ground will be thoroughly prepared by the advertisements and messages to the users referred to above, which are intended to eliminate what is perhaps the greatest difficulty of the salesman—that of getting the "prospect" interested. We are informed that considerably over 250,000 pieces of printed matter have had to be produced and collated for this campaign; the amount of detail work involved in a scheme of this magnitude can be readily imagined. We think that for the initiation and execution of a scheme of this nature and magnitude, which obviously will benefit not only the firm itself, but also the electricity supply undertakers, manufacturers, contractors, and last but not least important, the consumers, the Benjamin Electric, Ltd., deserves the cordial thanks of the whole industry.

A Celluloid Bill.—According to the *Birmingham Post*, already protests are being registered against the provisions of a Bill the London County Council intends to promote in the new Session to regulate the sale and storage of celluloid. The Celluloid Act of 1915 is proposed to be so amended as to provide that warehouses and shops in which articles containing 10 per cent. or more (by weight) of celluloid are kept or stored in such quantities that the weight of celluloid exceeds in the aggregate 112 lb., shall be included within the statutory definition of a celluloid stores, thus becoming registerable, and having to adopt certain precautions against fire. At present the storage of celluloid articles on wholesale or retail shop premises is entirely free from regulation; but the difficulty is to estimate the percentage of celluloid present in a given manufactured article, and in many cases it is asserted the amount is so small as to be a negligible quantity as far as fire risks are concerned.

The Cable-Makers' Association.—We are asked to state that, in accordance with a rearrangement of the organisation of the Cable-Makers' Association, Mr. Llewelyn B. Atkinson, M.I.E.E., who took up the secretaryship of the Association during the war, will in future act and sign as Director. The secretary in future will be Mr. W. G. Stiles, F.C.I.S., who has been assistant secretary for some time past.

American Plant for Japan.—The Nippon Electric Power Co., of Osaka, Japan, has given the contract for the supply of overhead transmission cables and sundries, for a service of 140 miles, to the Blaw-Knox Co., of Pittsburg, Pa., U.S.A., says the *Financier*.

Industrial Administration.—We have received a copy of the first number of *The Journal of Industrial Administration* (January, 1s. 6d.) It is edited by Mr. E. T. Elbourne, and contains a report of addresses and discussions before the Institute of Industrial Administration at Westminster, and in the general notes we observe particulars of two instructional courses which have been arranged by the management, dealing with Production Estimating and Production Costing.

A North Sea Ferry.—On January 12th a conference was held between delegations of Swedish and British business men to discuss the establishment of a ferry between this country and Sweden. Mr. Ahlberg, who holds a high position in the Swedish State Railways, indicated some of the advantages attendant upon such a scheme. The ferry ship, designed by Mr. Hok, would be constructed to carry a load of 500 tons in trucks. It was suggested that there should be four of these placed in service; the journey to and from Sweden would take four days.

Industrial Depression.—In the Special January Number of *The British Trade Review*, Mr. F. G. Kellaway, P.C., M.P., head of the Department of Overseas Trade, contributes an article tracing to-day's commercial depression to its origins in the war period, and exhorting British producers and traders the world over to realise that "courage is the need of the moment." Elsewhere it is shown that conditions all over the world are much the same at present; most countries find it difficult, it is remarked, to sustain the progress made in the "boom" at its height a year ago. Commerce is now organised to such a pitch that the prosperity or failure of any of the great trading powers has immediate effects on the condition of the rest.

LIGHTING AND POWER NOTES.

Abersychan.—Electricity Supply.—The Urban District Council is applying to the Electricity Commissioners for powers to generate and supply electricity in the Urban District of Abersychan, and to sell electric fittings, apparatus, &c., and to open showrooms, &c.

Belfast.—Extensions Needed.—In a report to the City Council, Messrs. Preece, Cardew & Rider stated that the probable maximum demand for the coming winter would be 21,740 kW, and this would increase to 28,240 kW in 1922. The present safe maximum combined output of the East Bridge Street and Harbour stations was 19,000 kW. A deduction of 500 kW would have to be made from this total for the working of auxiliary plant. Provision had been made for the installation of a 12,500-kW set at the Harbour station, but further extensions would have to be considered within the next 18 months. It was estimated that the total cost of completing the first section of the Harbour station and a sub-station with necessary feeders and distributors for the Ballymacarret district would be £361,800. The minutes of the Electricity Committee embodying the report were adopted.

Birkdale.—Price Increase.—The Electricity Supply Co. has signified its intention of raising its charges to the same level as those of the Southport Corporation. Birkdale is a part of the borough of Southport.

Birmingham.—The Case for Extensions.—The City Council, last week, adopted the recommendation of the Finance Committee, and deferred the question of proceeding with the second scheme for the enlargement of Nechells generating station owing to financial stringency. Mr. E. P. Beale, the chairman of the Electricity Supply Committee, made a strong appeal to the Council not to hinder the work of the department. He pointed out that the whole of the plant was working at its fullest capacity, and that there was no spare plant of any kind to take the load of any machine that might break down. The supply of power was so short that they had had to buy bulk supplies from the Dunlop Rubber Co. to the extent of 12,000 h.p., and from the Shropshire, &c., Electric Co. to the extent of 4,000 h.p. Many manufacturers had been placed on short supply, with the result that hours of work had had to be curtailed. The department was unable to take over any new business, and there were now between 3,000 and 4,000 applications for energy for power or lighting. Some of these people had been waiting for supplies for several years. Mr. Beale contended that a plentiful supply of power was absolutely vital to a manufacturing city like Birmingham, and the expenditure proposed would be wholly productive. Alderman Williams, chairman of the Finance Committee, expressed the hope that within a year it might be possible to finance the undertaking, but at present it was out of the question.

Blackpool. — Loan Sanctioned. — The Council has received permission from the Electricity Commissioners to borrow the sum of £30,000 for additional plant and extension of the power-station buildings.

Bo'ness.—Extensions.—The Town Council is applying for permission to extend the electricity works and to install a 1,000-kW turbo-generator and a new boiler, at an estimated cost of £45,000.

Carmarthen.—Cost of Street Lighting.—The Town Council, on Wednesday, considered a letter from the manager of the Carmarthen Electric Light Co., asking the Council for sanction to a further increase of 50 per cent. on the charge for public lighting. An increase of 20 per cent. had already been granted. The company urged that it had to bear an increased cost of over 200 per cent. above the pre-war level. The Council refused the application.

Clones (Co. Monaghan).— Public Lighting.— The Urban Council received a bill for £70 10s. for the last quarter's public lighting by the local electric lighting company. During a discussion it was asserted that the lighting was "too strong," and representations are being made to the company on this subject.

Continental. — Denmark. — The Gudenaa-Central, at Tange, in Central Jutland, was to be officially inaugurated on January 8th. This new hydro-electric power station, which is the largest of its kind in Denmark, has six turbines which drive three generators and can develop 6,000 h.p. The fall is 9·5 metres. The power station was built by Hampman, Kierulff and Saxild; the Swiss firm, Brown & Boveri, supplied the electrical distribution plant; the turbines were made by a Swedish firm, while the generators were manufactured by a Danish company, A/S Titan. A high-pressure cable leads direct to Aarhus, where a large new transformer station has been built. A similar cable connects Skive with the power station. Power is generated at 10,000 V, which is then transformed to 50,000 V, at which pressure it is conveyed to Aarhus and Skive. The total cost of the new works is estimated at 10 million kronen.—*Reuter's Trade Service* (Copenhagen).

Belgium.—Out of the 53 concessions for the supply of electrical energy for lighting and power purposes in Flanders held by the company, the Société des Centrales Électriques des Flandres is at present supplying 40, the total number of consumers being 12,700. The power station at Langerbrugge has at present a capacity of 10,600 kW, but this will shortly be increased by the addition of a new 6,600-kW turbo-generator. In addition, arrangements have been made to increase the capacity of the plant to 24,000 kW, as

soon as this becomes necessary. The high pressure (12,000 V) distribution system has been increased by 40 miles, and now extends to nearly 140 miles, while in addition there are 156 miles of low-pressure mains and 100 transformer stations with a total capacity of 14 000 kVA.

Cuba.—SALE OF GERMAN STATIONS.—The Electric Light and Power Investments Co., of Berlin, which owns three small electricity supply works in Cuba, is in negotiation for the sale of two of the works, and the transaction has so far proceeded that the transfer will be effected at a profit in dollars.

Dundalk.—NEED FOR EXTENSIONS.—In submitting three alternative schemes for the augmentation of the municipal generating plant, Mr. Spalding, the engineer and manager, states that at certain peak load periods the output of the station has been 14 per cent. in excess of its generating capacity—the difference being met by the storage batteries. The following are the suggested schemes :—(*a*) Extensions comprising one 500-h.p. steam engine with boiler, chimney, economiser and accessories ; (*b*) one 500-h.p. gas engine with producer plant and accessories ; (*c*) one 300-h.p. Diesel engine and accessories. Mr. Spalding recommends Scheme (*c*), which although engendering a higher capital cost than the others, will prove more economical in working. His second choice falls on Scheme (*a*).

Electricity Districts.—SOUTH WALES.—The latest date for the receipt of representations regarding the South Wales Electricity District has been altered to October 31st, 1921, instead of April 30th.

NORTH WALES AND CHESTER.—The Electricity Commissioners will hold a local inquiry at the Assembly Room, Town Hall, Llandudno, on February 15th, 1921, at 10.30 a.m. and following days, with reference to the area to be included in the above-named district, and the schemes which have been submitted by the North Wales Power and Traction Co., Ltd., and the Corporation of Chester for the formation of a Joint Electricity Authority. Copies of the respective schemes may be obtained from the North Wales Power and Traction Co., Ltd., Clark Street, Dolgarrog, North Wales, at a cost of 5s. each, and from Mr. J. H. Dickson, Town Hall, Chester, at a cost of 3s. 6d. each.

Falmouth.—PROPOSED PRICE INCREASE.—The Town Council is again protesting against an application of the local electricity supply company for permission to increase its charges from 7d. to 1s. 2d. per unit. The existence of a four years' street-lighting agreement has been brought to the notice of the Ministry of Transport.

Frinton.—PROPOSED PRICE INCREASE.—The Urban District Council is lodging an objection to the application of the Frinton Electric Light and Power Co. for permission to increase its maximum charge from 9d. to 1s. 2d.

Gillingham (Kent).—LOAN.—The Town Council is applying for sanction to a loan of £10,000 to cover expenditure on mains for the ensuing two years, and an overdrawal of accounts in this connection.

Halstead (Essex).—ELECTRICITY SUPPLY COMPANY.—A limited liability company, with a capital of £12,000, has been formed with the object of supplying electric lighting and power to the town.

Harrogate.—LOAN.—The Town Council is applying for the sanction of the Electricity Commissioners to the borrowing of £6,390 for the installation of a new condensing plant at the electricity works.

Llandaff.—LOAN SANCTIONED.—The Llandaff and Dinas Powis Rural District Council, Cardiff, has received sanction from the Electricity Commissioners to borrow £3,782 in connection with the electrical undertaking.

Lyme Regis.—PURCHASE OF UNDERTAKING.—The Town Council on January 11th decided to exercise the option of purchasing the electricity supply undertaking for £4,250, subject to safeguards as to the loan being forthcoming. Mr. H. T. Tilley, who was engaged as valuer, estimated the installation to be worth £3,869. The prices given in the report for the existing generating plant, meters, poles, &c., were those which he would expect to be obtained at the present time, but the figures for the overhead and underground cables were what he considered them to be worth as an installation. Considerable outlay would have to be made in the near future. The approximate outlay necessary to install a new generating set, cables, &c., now required, would be £5,895.

Newport (Mon.).—EXTENSION OF SUPPLY.—The Corporation is applying to the Electricity Commissioners for powers to extend the area of supply of electricity to include the parishes of Bettws, Duffryn, Malpas, and St. Woolos, the urban district of Caerleon, and the parishes of Christchurch and Nash, all in the county of Monmouth.

New Zealand.—LAKE COLERIDGE.—For the financial year ended March 31st, 1920, the load on the Lake Coleridge, N.Z., power house increased from 5,900 kW to 7,066 kW, the stated plant capacity being 6,000 kW. The capital outlay increased during the year from £403,157 to £422,076, the increase being mainly in making provision for a new generator of 4,000 h.p. now being installed. The revenue for the year was £45,831, and expenses as follows :—Working expenses, £17,759 ; interest, £16,863 ; depreciation and reserve, £7,624 ; total, £42,246. The result of the year's operation is thus a net profit of £3,585 towards reducing the deficit on the four previous years' working. The revenue for the previous year was £37,324, and the expenses £40,159, the deficit being £2,835. The deficit in 1915-16 was £17,649 ; in 1916-17, £11,956, and in 1917-18, £4,241. The output for the year from the power house was over 33,000,000 units.—*Commonwealth Engineer.*

Slaithwaite.—ELECTRICITY SUPPLY.—The Huddersfield Corporation is applying to the Electricity Commissioners, under the Electricity Supply Acts, for an order authorising it to supply electricity for all public and private purposes within the urban district of Slaithwaite.

Torquay.—INTERVIEW WITH COMMISSIONERS.—At a recent meeting of the Town Council a report was received from the deputation which interviewed the Electricity Commissioners in November last. The deputation pointed out that to raise the sum of £250,000 necessary for the suggested erection of a power station at Newton Abbot, was at the present time impossible, unless assistance was obtained from the Government. Failing that, it might be possible to induce a private company to carry out the scheme. Sir John Snell, in reply, stated that the erection of a new station in the area was very necessary. The Commissioners had no funds for the subsidisation of schemes, and he knew of no company that would be likely, or willing, to take over Torquay's obligations. In any case, it would cost a company more to raise the necessary capital, which would engender higher charges for electricity. If, however, the Council still favoured recourse to a private company, Sir John recommended approaching the Urban Electric Supply Co., now supplying part of the area.

The engineer was instructed to report upon the suitability or otherwise of the Medical Baths site for a power station, and also to ascertain from the company supplying Newton Abbot if it would be prepared to enter into a contract for a bulk supply from the Newton Abbot station when erected.

Tredegar.—LIGHTING ORDER.—The Council was recently reminded that the provisions of the clause in the Tredegar Parliamentary Bill relating to electricity had to be carried out within a period of two years, and that the proposed scheme had to be presented for approval within six months. It was decided to frame a scheme for submission immediately.

Truro.—LIGHTING ORDER.—The Electricity Commissioners have written to the City Council asking what steps have been taken in the carrying out of the provisions of the Electric Lighting Order granted in 1913. The question was referred to the Finance Committee.

Walsall.—CONDENSING WATER SUPPLY.—The Town Council proposes that, subject to the approval of the Board of Trade and the Electricity Commissioners, an agreement be entered into with the Birmingham Canal Navigations, under which the Corporation will pump canal water from one level of the canal to another, sufficient to meet the company's requirements, and utilise the water for condensing purposes at the Corporation generating station. The company will be relieved of certain pumping work now carried out by it, and is to pay the Corporation £3,000 per annum. The scheme involves a capital outlay of £24,000, of which amount £14,000 is included in £119,500 which the Corporation is authorised to expend in the completion of the generating station. —*Birmingham Post.*

Walton-on-Thames.—PROPOSED PRICE INCREASE.—The Urban District Council has decided to oppose the application of the Urban Electric Supply Co. for sanction to further increase charges for electricity.

Warrington.—OVERLOADED PLANT.—The Electricity Committee finds itself unable to meet fully the demands of its consumers. The Ministry of Transport has sanctioned the purchase of two 6,000-kW turbo-generator sets (three were authorised by the Council), but delivery is not expected until the beginning of next year.

Warwick.—INQUIRY.—On January 11th, an inquiry was held by the Ministry of Transport into the application of the Warwick and Leamington Electrical Co. for permission to increase its charges. The town clerk said that it was unfair to fix prices for five years at a time when the cost of production was at a maximum. He also asked for an adjournment of the inquiry, complaining that he had received none of the data upon which the proposed increased prices were based. A fortnight's postponement was agreed to.

West Hartlepool.—The Corporation is applying to the Electricity Commissioners for a special order to extend the area of supply of electricity to include part of the parish of Stranton in the Rural District of Hartlepool.

TRAMWAY AND RAILWAY NOTES.

Australia.—MELBOURNE.—Although the profit from the tramway system is stated to be "infinitesimal," the Tramway Board has decided not to increase the fares. The Melbourne system will therefore still be one of the cheapest, if not the cheapest, for travellers in the whole world.

Bradford.—PROTEST AGAINST RAILLESS CARS.—The proposed substitution of railless traction in place of the present rail traction on the Idle and Thackley routes has raised a

storm of protest from residents in that district, and opportunity is to be afforded them for protesting before any decision to effect a change is made.

Chile.—Railway Electrification.—Provision is to be made in the new loan of £7,775,000 in gold by the Government of Chile for the electrification of the State railways, the purchase of new equipment, and the operating deficits for the past three years. —*Financial News.*

Continental.—Sweden.—The question of the electrification of the Swedish State railways, and particularly of the line between Stockholm and Gothenborg, appears to have entered upon a new stage since the return from the United States of Mr. Granholm, general manager, and Mr. Oiverholm, principal of the electrical department of the State railways. It was decided some time ago to adopt the single-phase system, as used on the frontier railway, for the projected conversion of the Stockholm-Gothenborg line, and a sum of 75,000,000 kronen was voted by Parliament for the purpose. Before these decisions were reached the Special Committee which investigated the problem of electric railway working suggested that firms representing the direct-current system should also be permitted to submit offers, but the Railway Administration rejected this recommendation on the ground that a postponement of a decision as to the choice of a system would only aggravate and confuse a problem which was already difficult, without obtaining any counterbalancing advantages. The working of the direct-current system in the United States, however, has created a favourable impression on the general manager and the electrical engineer, and it is now assumed that the question of the system to be adopted will undergo re-examination. In discussing the question, a Swedish newspaper suggests the possibility of the direct-current system being decided upon as possessing great advantages, and that in this event it would be impossible for Swedish firms to deliver the plant on account of the lack of that experience in this direction which would permit of their successfully competing with foreign rivals, and the Americans in particular. It would not be good economy in these times of scarcity of money, the newspaper remarks, to borrow 75,000,000 kronen, of which a considerable amount would cross the Atlantic; and it is, therefore, suggested that the most appropriate course to adopt would be to postpone the whole question, while in the meantime Swedish firms would be able to render themselves capable of rescuing for Swedish industry a Government order of great economic and national importance. Two or three days after this expression of opinion the Allmänna Svenska Co. announced that the company was fully equipped and competent to co-operate in the electrification of the railways, and that the question had already been discussed with representatives of the United States General Electric Co., who launched the direct-current system. It was added that it would be of advantage for the Swedish company to co-operate with the American company in the matter, although an agreement had not been entered into for the purpose.

Germany.—The electric tramway system in Berlin, which was formerly owned by a company that paid dividends of up to 8 per cent. per annum, and which was acquired by the municipal authorities a few years ago, now shows a deficit of 74,000,000 marks. Despite constant increases in the fares it has been found impossible to balance income and expenditure, and the adverse balance is growing month by month.

Italy.—The *Morning Post* states that a violent scene occurred at the sitting of the Rome Municipal Council on January 13th, when a number of disabled ex-soldiers, armed with sticks, invaded the Council chamber and endeavoured to compel the concession of free tickets on the municipal tramways. The system is already overcrowded and working at a loss, but a compromise was reached by which all wounded ex-soldiers are to be allowed to travel free until Feb. 28th. During the interval a mixed Commission is to investigate the matter. Similar demands have been advanced in Milan. The Roman car fares have been nearly trebled, the lowest fare being 40 centesimi.

France.—A scheme has been submitted for approval to the Conseil Général du Departement de la Savoie for the complete electrification of the tramways of the Department. Four networks are in contemplation. The first is the Chamberg network, comprising 26 lines; the second network is constituted by the Albertville to Beaufort-sur-Doron line; the third and fourth networks embrace seven lines, at present partially served by electric trolley cars. The networks will be served by a conduit system, and the total length of the lines projected is 200 km., the estimated cost being about 80,000,000 fr.

Durham County. — Transport Scheme. — Durham County Council, on January 12th, decided to proceed with its county transport scheme, in connection with which a Bill has already been deposited in Parliament to empower the Council to construct and work tramways and to provide trolley vehicles, motor omnibuses, &c. The scheme is estimated to cost £1,631,473, of which £847,122 is for the construction of tramways and tramroads, £397,770 for the provision of electrical equipment for tramways and trolley vehicles, £120,000 for the provision of tramway rolling stock, and £143,000 for provision of trolley vehicles. Sir A. M. Palmer, in opposing the scheme, said the opposition was so great from all quarters of the county, from landowners, coalowners, local authorities, and others, that he did not think Parliament would pass the Bill. He agreed that the days of tramways were gone, and if the Council wanted anything of the kind, it should operate motor-buses. The Council went into Committee to hear the opinion of experts before coming to its decision. As the majority in favour was not a majority of the whole Council, it is expected a further meeting of the Council will have to be held to consider the matter.

Liverpool. — Proposed Purchase. — The City Council has accepted a recommendation of the Tramways, Electric Power, and Lighting Committee that, subject to the necessary power being obtained, the Corporation should acquire from the St. Helens Corporation the section of the line between Brook Bridge and Moss Street, Prescot, being Tramway No. 1, authorised by the St. Helens Corporation Act, 1898, with the right to make use of the lines between Moss Street and the King's Arms, Prescot, including the loop line and the triangle, at a price of £8,000.

New Zealand.—New Plymouth.—The municipality is purchasing new cars, &c., at a cost of £22,500. A proposal to extend the present system and to introduce railless cars, which would have cost £43,500, was defeated.

Rate-Relieving Tramways.—Comparative Figures.—A useful, as well as interesting, return has been compiled by the borough treasurer of Preston, showing the extent to which the rates of various municipalities have been relieved by municipal enterprise, tramways, &c. Bootle and Wallasey head the list with 1s. 11d. from the tramways, &c.; Liverpool, 6½d.; Manchester, 11d.; Birmingham, ¾d.; Leeds, 1s. 9½d; Birkenhead, 3½d.; Chester, 5½d.; St. Helens, ½d.; Southport, 4d.; Warrington, 11½d.; Wigan, 1d.; and Widnes, 1½d.

Shipley. — Power Rate Increased. — The Council, having applied for an increase in the rate of payment for electricity used on tramways leased to the Bradford Corporation, has been informed that the present rate of payment will be increased by ½d. per unit on the recommendation of the Bradford Tramways Committee. The increase is retrospective to October 1st last.

TELEGRAPH AND TELEPHONE NOTES.

Cable Delays.—The delay to which the whole of the cable traffic from the East has been subject is attributed by the *Daily Mail* to the fact that on Christmas Day a fishing trawler fouled its anchor in several of the Eastern Telegraph Co.'s cables lying off the Portuguese coast.

Storm Damage.—It was announced by the General Post Office, on Tuesday last, that there would be telegraphic delay to France, Germany, and Switzerland, owing to the storm during the early part of the week. Communication between different parts of England and also with and in Ireland was also made difficult.

China.—New Wireless Stations.—The American Federal Wireless Telegraph Co., of San Francisco, has signed a contract to erect powerful main wireless stations at Shanghai, Peking and Harbin at a cost of $1,200,000. It will be a joint Chino-American operation to be controlled by the Ministry of Communications; after 10 years the system will revert to China.—*Reuter's Trade Service* (Peking).

France.—Wireless Society.—There has been formed at Paris a society for those interested in wireless telegraphy, under the title of the Radio-Club de France. Its objects are to popularise wireless telegraphy by every means of propaganda, and in particular by setting up research laboratories at its offices, and also in the principal centres; likewise, workshops, reading rooms, and library. Other objects are stated to be visits to stations and laboratories, maintaining relations with like associations abroad, assistance to inventors and research workers, obtaining of situations, and affording pecuniary assistance to members in difficulties. Its offices are at 95, Rue de Monceau, Paris.

Italy.—Telegram Surcharges.—As from January 15th, the surcharge on telegrams to and from Italy was increased to 300 per cent., says *The Times*.

Japan.—New Wireless Station.—The wireless station at Tomioka was opened on January 11th. It is the most powerful station in the Orient, and is receiving messages direct from New York and other big world stations. Experiments in sending messages have proved very successful, and the station will commence dispatching about February 1st.—*Reuter's Trade Service* (Tokio).

Sweden.—Telegraphic Communication with Russia.—The Great Northern Telegraphic Co., of Copenhagen, is negotiating with the Government of Sweden and the Russian Soviet Government with a view to the resumption of telegraphic communication between Stockholm and Petrograd. At present the only connection which exists is the wireless one which Prof. Lomonosov has with Moscow. The company's property in Petrograd has been respected, and both it and the Swedish Telegraph Administration are prepared to resume communication at any moment. The company's Asiatic and Siberian service was maintained during the years of war with few exceptions in the case of connections with Irkutsk and Vladivostock, where transitory interruptions took place. But the connection between Europe and the East of Asia *via* Russia has been entirely at a standstill, and the company in later years has been compelled to maintain communication with its East Asiatic service through English cables *via* India. Now the intention is to re-establish the connection between European Russia and Eastern Asia at the same time as the recommencement of the service in Russia.—*Financier*.

U.S.A.—WIRELESS PRESS FACILITIES.—The American Publishers' Committee has sent a representative to this country for the purpose of urging the need of improved facilities for the transmission of news between Great Britain and the United States. According to *The Times*, Mr. Joseph B. Pierson, chairman of the committee, who is now in London, says that the committee was organised by the cable-using newspapers and Press associations of the United States for the purpose of securing better transmission service for news dispatches to and from all other parts of the world, but chiefly with England and France. The committee has the support of the leading officials of the Government at Washington, which has placed the extensive high-power wireless facilities of the United States Navy at its service. It is using those facilities to the extent of several thousand words daily, particularly in the Far East, and there are adequate facilities for increasing wireless messages between England and America as soon as England increases its wireless stations. It is for the purpose, Mr. Pierson says, of establishing better facilities, that the American Publishers' Committee has sent its representative to England. "Better facilities are possible, and, in fact, are in operation between France and America. The committee has the energetic co-operation of the Newspaper Proprietors' Association of London, and hopes to secure the sympathetic consideration of the British Post Office. We are asking that England should develop wireless facilities to work with American stations, and that the cables be cleared for certain short definite periods in the night and in the day for the swift transmission of news under organised management of the newspapers and news associations." Mr. Illingworth, Postmaster-General, agreed to receive a deputation from representative Press organisations last Wednesday on the subject of telegraphic communication by cable and wireless.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—February 21st. Corporation Waterworks Department. Electrically-driven pumping machinery. Specifications, £5 (returnable), from Water Engineer's Office, 41½, Union Street, Aberdeen.

February 21st. Electricity Department. Temporary and permanent coal conveyors and shutes in connection with the reconstruction of the boiler house at Ferryhill. (See this issue.)

Australia.—SOUTH AUSTRALIA.—P.M.G.'s Department. March 2nd. Telephone parts, Schedules 558 and 559; telegraph and telephone material, Schedule 560. (January 7th.)

MELBOURNE.—March 2nd and 9th. Victorian Railways. Reactances and condensers (for power signalling), electric crabs and equipment for cranes. Copies of the specifications can be seen at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W. 1.

March 31st. Electricity Commissioners. Plant for the Morwell power scheme. Telephone wire and pin-type insulators. (January 14th.)

ADELAIDE.—February 23rd. P.M.G.'s Department. Electric lamps, as per Schedule 561. (See this issue.)

SYDNEY.—March 21st. P.M.G.'s Department. Telephone and telegraph apparatus, testing instruments and switchboard parts, Schedule 814. (See this issue.)

PERTH, W.A.—March 29th. P.M.G.'s Department. Telegraph accumulators, Schedule 333. (See this issue.)

Belgium.—February 1st. Municipal Council, Antwerp. Rotary converters with switchboard, for No. 77 Wharf of the Bassin Canal. Specification in French can be seen at the Inquiry Room of the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

February 3rd. Municipal authorities of Molenbeek-Saint-Jean, near Brussels. Supply of the necessary electricity meters required in connection with the local electricity supply undertaking. Particulars may be obtained from the Hotel Communal, Molenbeek-Saint-Jean, Brussels.

February 11th. Municipal authorities of Tirlement. Electricity supply in the town; (1) the supply of electrical energy; (2) the establishment of a distribution system; and (3) the concession for the supply of electrical energy for lighting and power purposes. Specification from the Secretariat Communal, Tirlement, on payment of 30 fr. The municipal authorities will decide as to the scheme to be adopted after the tenders have been opened.

The Belgian State Railway authorities, at La Salle Madeleine, Brussels, are about to invite tenders for the supply of a large quantity of miscellaneous material in connection with the electric lighting of trains.

Chester-le-Street. — January 25th. Urban District Council. Wiring 512 houses, feeder cables, overhead mains, equipment for sub-station. (January 14th.)

Edinburgh.—January 24th. Electricity Supply Department. Circulating water pipes and valves for the Portobello generating station, Specification No. 30. (January 7th.)

France.—PARIS.—February 17th. The supply and installation of a multiple commutator table at the Central Telephonic Bureau in the Boulevard Raspail. Particulars from the Direction de l'Exploitation Téléphonique, 4e Bureau, 103, Rue de Grenelle, Paris.

Great Yarmouth.—February 11th. Electricity Department. Supply and erection of h.p. switchgear. (See this issue.)

Haiti.—*Le Moniteur*, the official journal of the Republic, publishes details of a contract between the Haitian Government and a firm at Jacmel for the erection of a hydro-electric plant in Port-au-Prince. There is to be one generating station and one sub-station, the former being provided with two 100-kW sets, comprising a Pelton wheel driving a three-phase 42-cycle, 600-V alternator, with the necessary switchgear and accessories. The power is to be conveyed to the sub-station by an overhead line at 8,000 V, and the consumers' voltage is to be 220. Applications for the name of the firm in Jacmel should be addressed to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, quoting 2619/FI/PN.

Halifax. — February 3rd. Electricity Department. Twelve months' supply of stores, including electric lighting fittings and accessories, cables, v.i.r., and phosphor bronze, telephone wire, e.h.p. and l.p. cables, meters, &c. (January 7th.)

Keighley. — January 24th. Corporation. Electricity Department. Construction of 6,600-V overhead line to Easeburn. (January 14th.)

London.—HAMMERSMITH. — January 26th. Electricity Department. Single and three-phase transformers. (January 14th.)

PADDINGTON.—January 24th. G.W.R. stores, including telegraph instruments, electrical apparatus, electric wire and cable, &c. (January 14th.)

L.C.C.—January 31st. Electric wiring installation at the Bethnal Green Weights and Measures Office and Coroner's Court, comprising about 87 switch points and 89 lighting points. (January 14th.)

H.M. Office of Works. February 1st. Six months' supply of switches, fuses and fuseboards. (See this issue.)

Lurgan.—January 29th. Urban District Council. Four-core l.p. lead-covered and armoured cables. (January 14th.)

Manchester. — January 26th. Electricity Committee. Direct-current switchgear for Dickinson Street generating station. Mr. F. E. Hughes, secretary, Electricity Department, Town Hall.

February 14th. Electricity Department. 33,000-V trunk feeder, pilot and telephone cables. (See this issue.)

Middlesbrough.—February 9th. Corporation. Double line of tramways from Albert Road to Linthorpe Road. Particulars from Mr. S. E. Burgess, Borough Engineer, Municipal Buildings.

New Zealand. — WELLINGTON. — March 1st. Public Works Tender Board. Seven 4,000-kVA single-phase transformers, with accessories, for Lake Coleridge electric power scheme. Copy of the specifications can be seen up to January 20th at the Department of Overseas Trade, Room 48, 35, Old Queen Street, S.W. 1.

Rosyth.—January 30th. Electric lighting work at Park Road School. Deposit, £1 1s. Mr. R. H. Motion, architect, Union Bank Chambers, Dunfermline.

South Africa. — PRETORIA.—March 10th. Municipal Council. One 20-ton overhead crane, six boilers (350-lb. working pressure), three 3,000-kW steam turbo-generators with condensing plant, five 750-kW converters. Further particulars can be obtained from Mr. T. C. Wolley-Dod, general manager, electric lighting department. Specifications (five guineas) from the town clerk.

DURBAN.—January 26th. Corporation. Supply of telephone cable, paper sleeves, concrete pipes, and various telephone and miscellaneous accessories and materials.

February 16th. One 1,000-kW rotary converter with transformers and switchgear. Specifications of the above may be consulted on application to the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Uruguay.—MONTE VIDEO. — May 29th. State Power House. Single and three-phase meters. Copy of the specification (in Spanish), conditions of tender and a list of spares to be provided (also of a similar call for tenders for 500 d.c. meters for the provinces), can be seen at the Department of Overseas Trade (Room 48), 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Eight tenders were submitted to the Municipal Authorities of Ixelles, Brussels, last week, for the supply and erection of a steam turbine and alternator at the local electricity generating station. Four of the tenders came from Belgian firms, one of which quoted for either Belgian, Swiss or French plant, two quotations came from French firms, one from Brown, Boveri and Co., of Baden, Switzerland, and one from the Swedish Turbine Works (Ljungström), of Finspong, Sweden. The prices quoted ranged from 850,000 francs to 1,525,000 francs.

Glossop.—Town Council. Accepted:—
Aerial feeders, for electric lighting, on three sites, £325.—J. Swainson & Co

Leigh.—Town Council. Accepted:—
One 3,500 kW turbo-alternator, £18,694.—Fraser & Chalmers Engineering Works.
E.h.t. and l.t. switchgear, £2,420.—Ferguson, Pailin, Ltd.
One 500-kW La Cour converter, £4,070.—Bruce Peebles & Co.

Sunderland.—Corporation. Accepted:—
Spare parts for A.E.G. turbine.—J. Howden & Co., Ltd.
Spare parts for coal conveyor.—Babcock & Wilcox, Ltd.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, January 21st. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "The Mechanical Loading of Ships," by Mr. H. J. Smith.

Junior Institution of Engineers.—Friday, January 21st. At the Caxton Hall, Westminster, S.W. At 8 p.m. Lecturette on "Motor Yachts," by Mr. B. H. Joy.

Salford Technical and Engineering Association.—Saturday, January 22nd, at the Royal Technical College. At 7 p.m. Presidential address by Mr. J. Morris. Musical social evening.

Institution of Electrical Engineers.—Informal Meeting.—Monday, January 24th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Discussion on improving the usefulness of the Institution.

Thursday, January 27th. At the Institution of Civil Engineers, Great George Street, S.W. At 6 p.m. Paper on "Temperature Limits of Large Alternators," by Mr. G. A. Juhlin.

North-Eastern Centre.—Monday, January 24th. At the Mining Institute, Westgate Road, Newcastle-on-Tyne. At 7.15 p.m. Paper on "Some Economic Aspects of e.h.t. Distribution by Underground Cables," by Mr. R. O. Kapp.

North-Midland Centre.—Tuesday, January 25th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "The Distribution of Electricity," by Mr. W. B. Woodhouse.

South-Midland Centre (Students' Section).—Tuesday, January 25th. At the Birmingham University. At 7.30 p.m. Paper on "Thermionic Valves," by Mr. J. A. Cooper.

Manchester Wireless Society.—Wednesday, January 26th. At 7.30 p.m. At the Albion Hotel, Manchester.

Royal Society of Arts.—Wednesday, January 26th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "The Origin and Development of the Research Associations established by the Department of Scientific and Industrial Research," by Mr. A. Abbott.

Belfast Association of Engineers.—Thursday, January 27th. At the Municipal Technical Institute. At 6.45 p.m. Paper on "The Mechanical Handling and Conveying of Materials," by Mr. R. P. Terry.

Chelmsford Engineering Society.—Thursday, January 27th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Electric Winders for Collieries," by Mr. C. S. Buyers.

Liverpool Engineering Society.—Thursday, January 27th. At the Exchange Hotel, Liverpool. At 7 p.m. Annual dinner.

Edinburgh Electrical Society.—Friday, January 28th. At the Philosophical Institute. At 8 p.m. Papers on "Electrical Wonders in Guernsey," by Mr. E. C. Catford.

Physical Society of London.—Friday, January 28th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Association of Engineers-in-Charge.—Saturday, January 29th. At St. Bride's Institute, Bride Lane, E.C. At 7 p.m. Discussion on "The Association and its Future Activities." To be opened by Mr. A. E. Penn.

Manchester Association of Engineers.—Saturday, January 29th. At the Memorial Hall, Albert Square. At 7 p.m. Paper on "Cast Iron v. Semi-Steel," by Mr. E. Wheeler.

NOTES.

The "Electrical Review" Index.—The Index to Vol. LXXXVII of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 6d., post free. Any reader or advertiser, at home or abroad, who requires a copy for binding or for other purposes, is asked to make early application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

Freemasonry.—The next regular meeting of the Kelvin Lodge will be held at Mark Masons Hall, Great Queen Street, London, W.C. 2., on Friday, 28th inst., at 4 p.m.

Electricity on Board Airships.—Commenting upon the passenger airships, R. 36 and R. 37, which are being built for the Civil Aviation Department of the Air Ministry, the *Daily Chronicle* states that electric cooking apparatus is to be installed, in addition to many other details to cater for the comfort and convenience of passengers.

Edison on the After-Life.—An interview with Thomas Edison, the inventor, is published in the current issue of the *London Magazine*. Although Edison does not express any definite views as to the persistence of conscious life after death, it seems clear that he regards the subject as worth careful investigation. The apparatus he is perfecting, if successful in enabling the people of this world and the spirits of the next world to communicate with each other, will cause, he says, "a tremendous sensation." Whatever Edison may have concluded as to the after-life, he is very definite as to whether the earth and its life exists simply as a result of an accident. He says:—"I can no more doubt the existence of an Intelligence that is running things than I do the existence of myself."—*The Times*.

Appointments Vacant.—Telegraph engineers (£480) for the Nigerian Government; draughtsman (£6) (temporary) for the Wimbledon Corporation electricity department; plumber-jointer for the Corporation of Salford electricity department; plumber-jointers for the Burnley Borough Council electricity department. See our advertisement pages to-day.

Norwegian Rustless Steel.—*Berlingske Tidende* learns from Christiania that the Norsk Electro-Kemisk Aktieselskab, whose works are at Tyssе, has long been experimenting with a special ferro-chrome alloy, produced electrically, which will not rust, and which is not affected by most acids. The process of production is said to be so cheap that the new steel will not cost more than other kinds. The company contemplates the establishment of works for the production of the new steel.—*Reuter's Trade Service* (Copenhagen).

The Engineers' Club for London.—On Monday last Mr. Edmund L. Hill was the guest of the Batti-Wallahs' Society at luncheon at the Holborn Restaurant, and delivered an interesting and inspiring address on the Engineers' Club for London, of which he is the hon. secretary *pro tem*. Referring to his intimate acquaintance with the Manchester Engineers' Club (of which he was one of the founders and hon. secretary), Mr. Hill mentioned that Mr. H. T. Wilkinson had played a leading part in setting on foot the movement in London. At Manchester the proposal had met with a good deal of hostile criticism, and some 18 months' hard work was required to establish the Club, but it was a huge success; it had 850 members, and a long waiting list, and had a building fund of £50,000. In London the amount of adverse criticism that had been received was practically negligible. The scope of the Club should be wide, including industries allied to engineering, and both the commercial and technical sides; it would be designed not only for London, but also for members from the Provinces and the Oversea Dominions throughout the Empire. There was a possibility of securing a temporary home for the Club, in which event a start might be made by midsummer. In order to improve the "load factor" members should use it to the full; they must provide a service so cheap and efficient that members could not do without it, including ample bedroom accommodation and really good food. With regard to the all-important question of finance, Mr. Hill gave a long list of the eminent gentlemen who had promised to serve on the preliminary Organising Committee, and would have to consider this subject; he deprecated the adoption of a high entrance fee, which would keep out young engineers, but thought that an annual subscription of 10 or 12 guineas would be necessary. The service of the Club must be perfect in all respects. Such an institution was an ideal worth working for—and it would involve a great deal of hard work, to provide a fitting and abiding home for the noblest profession in the world.

The chairman, Mr. W. E. Warrilow, drew attention to Mr. Hill's great work in connection with the Federation of British Industries. Mr. Wansbrough, president of the Cable Makers' Association, proposing a vote of thanks to Mr. Hill, said that no one was better fitted than he to start the Club, and Mr. Dixon, seconding, said it was a disgrace to London that it had no real meeting place for engineers. The vote was accorded with enthusiasm and musical honours, and Mr. Hill, in acknowledging it, pointed out that the movement was not due to himself alone, but to a number of promoters.

A New German Electric Car.—The *Motor* states that a new electric motor-car is being manufactured at the rate of 100 per month by a Berlin firm. The price of the car complete is 14,000 marks—at present exchange rates, about £56.

Detecting Faults in Coils.—In our issue of January 14th, page 52, we described a method for the detection of short circuits in motor armature coils outside the motor. A correspondent asks whether any of our readers can give a description of a similar apparatus for the motor coils already in position in stators and rotors. 110-V single-phase current is available on site.

The Ilford Shut Down.—As we go to press, we learn that at 6 p.m. on January 19th a conference was held between the Council and the Ministry of Labour (represented by Dr. Macnamara, Sir David Shackleton and Mr. H. F. Wilson). Following this conference, certain proposals were placed before a full meeting of the Council, when it was agreed to adopt the E.P.E.A. Schedule immediately, at the same time calling upon the Ministry of Labour to form a Board of Appeal to which recommendations for the revision of the terms of the Schedule might be submitted.

This decision was arrived at shortly after 8 p.m., and in less than half-an-hour normal work was resumed at the electricity works.

The Stoke Newington Contracts.—The Borough Council has decided to lodge an appeal against the recent decision of the Court in the matter of pre-war contracts with the North Metropolitan E.P.S. Co.

Swedish Enterprise in Russia.—According to the Swedish newspapers, the Vice-President of the Russian Supreme Economic Council has just declared that among the concessions in course of preparation is one for the Allmänna Svenska Elektriska A.B. of Västerås, which is invited to start the construction of turbines and other plant at the company's former works at Jaroslaw. On inquiry made at the office of the Swedish company, Mr. Linden, manager of the company, is reported to have confirmed the report that negotiations for this purpose have been opened, although they are in a preliminary stage. The proposal has been initiated by the Russian authorities, and the conditions put forward correspond with those fixed generally by the Soviet Government for all possible foreign concessions in Russia. In addition to the Allmänna Co., the L. M. Ericsson Telephone Co. and the Swedish Ball Bearings Co. are in negotiation with the Soviet authorities in the matter of concessions; and the latter are also said to be proposing to grant concessions to Americans and Germans for the establishment of tanning, dye and leather works, also concessions to English firms.

A First-Aid Appliance.—A giant eye-magnet for the removal of fragments of metal from injured eyes has been installed in the operating theatre of Preston Royal Infirmary. The instrument was designed by Mr. J. F. Simpson, tramway engineer, with the assistance of Mr. G. J. Gibbs, consulting electrical engineer. The cost has been defrayed by workmen engaged in the metal trades of the district.

Fatalities.—A youth of 16, named Leslie Harrison, of Handsworth, Birmingham, was recently killed whilst engaged at the works of Messrs. J. Grove & Sons, of Hales Owen. He was in the employ of the Staffordshire, Shropshire, and Worcestershire Electric Power Co., and was sent to do work in a cubicle, and he was warned that there were live wires in it. A cry was heard, and Harrison was found bending over the wires. His work had been completed, and the foreman stated at the inquest, at which a verdict of "Accidental death" was returned, that he thought that the lad returned to the box to have another look at it before it was inspected.

An inquest was held at West Leigh, on January 14th, on John Boardman (21), of First Avenue, Hindley, who, while passing along the colliery railway line, saw an electric cable fusing, and setting fire to one of the poles. Boardman went over the hedge, and a few minutes later a companion heard a scream, and saw flames shoot into the air. Boardman was found unconscious, and he died three minutes later. The fingers of his left hand were almost burnt through. A verdict of "Death from misadventure" was returned.—*Liverpool Post.*

A New Wireless Station at Northolt.—We have received some interesting particulars of a new wireless station which is being erected by the Post Office at Northolt, which is quite close to London, lying half-way between Uxbridge and Harrow. The aerial system will consist of a triangular network, each side of which will be 650 ft. in length, and the aerial will be supported by three Elwell wooden lattice towers, each 446 ft. in height. The earth system will consist of a network of copper strip connected to metal plates buried at the bottom of the excavations made to receive the stay wire anchorages, and the tower and building foundations. The transmitting equipment, both primary and secondary, will be Elwell-Poulsen arc generators fitted with remote control. The decision to install these arc generators was reached after alternative tenders had been obtained for valves and alternators. In the near future a valve set employing the latest practice in valves, viz., the high-power Mullard silica valves, will also be installed. When this has been done, comparative tests will be made to ascertain which system is the more economical and reliable in commercial operation. The specification calls for a minimum output of 50 A in the aerial, and arrangements are being made for the emission of a single wave when transmitting, and the complete suppression of radiation when spacing, instead of the usual de-tuning. It is believed that this will be the first arc station of any size to operate commercially on this principle. Many advantages are gained by being able to stop radiating when spacing, such as the saving in power, and the freedom from jamming which will result. Although the output to the aerial is quite considerable, the station will be operated directly from the Central Telegraph Office, London, at a speed of about 60 words per minute, but provision has been made for the use of high-speed signalling at more than 100 words per minute. The contract for the whole of the wireless equipment and masts has been placed in the hands of Mr. C. F. Elwell, who is at present also completing the two Imperial wireless stations at Oxford and Cairo. We published a fully illustrated description of the Elwell apparatus in our issue of April 2nd, 1920. The object of the new station is to give direct working to Central Europe, and the rates per word will be the same as the existing telegraph rates. The service should be vastly superior, however, as the use of lines passing through many different foreign countries will be eliminated.

Supply Company and Juvenile Employé.—The Plympton Electric Supply Co., South Devon, was summoned at Plympton Petty Sessions on Monday for two offences under the Factory Acts. One related to the unlawful employment of a young person on Sundays, and the second charge was that of employing him without procuring the requisite medical certificate. Mr. Joseph Owner, Inspector of Factories, told the Court that the Act laid it down quite clearly that an employer who employed any person under 16 years of age, must, within seven days of that employment, obtain from a surgeon in the district, a certificate of the physical fitness of the employé Defendants had been served with a notice in which that requirement appeared. A boy named Gill, who had been employed by the defendants for 15 months, had never been examined by a doctor, and no attempt had been made to get a medical certificate. The boy was also employed on alternate Sundays from 4 p.m. to 11 p.m., and it would be far better were a man employed to do the work. A fine of 10s. in respect of each summons was imposed.

Educational.—The curriculum of the "day continuation schools" under the Education Act, 1918, which commenced on January 10th, includes mathematics and science, as well as "practical subjects," such as mechanical drawing and workshop construction.

The Second Congress of the Universities of the Empire is to be held at Oxford early in July. Among the many important questions selected for discussion are "The Universities and Research," "The Universities and the Teaching of Civics, Politics and Social Economics," and "The Universities and Secondary Education."

German Lamp Production.—It is stated that the production of wire filament lamps in Germany in the financial year 1919 20 amounted to 59,520,000, of which 13,370,000 were for export markets, and, consequently, not liable to the tax on lamps. The number of carbon-filament lamps made was 4,680,000; incandescent gas mantles, 48,030,000, of which 3,760,000 were for export; and arc lamp carbons, 1,090,000 kg., of which 260,000 kilos were for external markets.

Swedish Alloy Discovery.—A quite new alloy of copper and aluminium without impurities—which have hitherto frustrated all previous experiments in the practical utilisation of the alloy—is reported to have been worked out for practical use by a Swedish factory. The new alloy has been named "alcobrons" As the material in question is not affected by salt water, it is specially adapted for ship's metal work, propellers, and condensing tubes, and it is said to be of considerable utility in other respects.—*Morning Post.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—On Thursday last week, Prof. Sir William Bragg, K.B.E., F.R.S., delivered the twelfth Kelvin lecture, taking as his subject "Electrons." Before a crowded meeting, the lecturer, starting "at the beginning," outlined in a most interesting and able manner the discoveries that have been made in recent years in connection with the subject. The President, Mr. Ll. B. Atkinson, announced that the Council had decided that descriptions of inventions or new patented devices should be accepted for publication in the Institution *Journal*. Such matter would be given priority of publication, and it was thought that the value of the *Journal* would thereby be enhanced.

NORTH-EASTERN CENTRE.—At a meeting of this Centre, held at Newcastle-on-Tyne, on the 10th inst., Mr. J. R. Beard, in the chair, Mr. Ll. B. Atkinson, President of the Institution, delivered an address, taking as his subject portions of that which he delivered in London, emphasising especially the application of electricity to agriculture, and electric vision. He then turned to what he called politics in industry and production, and spoke of social and industrial unrest. In reply to a question as to his association with the North of England, the President said he commenced his connection with mining in that district in 1885 or 1887, when the transmission of power by means of electricity was engaging the attention of no one more keenly than the mining expert. In that district he was mainly engaged in the application of electricity to coal-cutters, and the first large installation was that at the Lambton Collieries, where there was a generating plant of about 400 h.p.; the electrically-driven winding engine put down there was the first placed in the world. The dangers that might arise were the cable to be cut by a fall, turned his attention to that question, and he found its solution in the making of a split conductor. There was great difficulty in the working of the coal-cutters, because the organisation in those days was not what it was now. It was interesting to note that the coal-cutting machines used to-day hardly differed from the early ones, but it was needless to say that coal mines were very much better organised.

ASSOCIATE MEMBERSHIP EXAMINATION.—It is proposed, if a sufficient number of candidates make application, to hold in London, in April, 1921, an examination for associate membership. Arrangements will also be made for the examination to be held at Local Centres in the United Kingdom and abroad. Applicants desiring to sit for the examination should send their entry forms and examination fees in time to reach the Secretary of the Institution, 1, Albemarle Street, London, W. 1, not later than March 1st, 1921. Entry forms and copies of the examination regulations may be obtained on application to the Secretary.

LIVERPOOL SUB-CENTRE OF THE NORTH-WESTERN CENTRE.—Three papers on "Electric Welding" were read before this Sub-Centre, at the Laboratories of Applied Electricity, the University, Liverpool, on Monday last. Dr. J. H. Paterson dealt with "The Chemical and Metallurgical Aspects of Electric Arc Welding." He very briefly pointed out the difficulties yet to be overcome in electric welding, especially on the metallurgical side, and hinted that there was a very wide field open for research. Mr. L. B. Wilson dealt with "The Cost of Electric-Resistance Welding," and gave some very interesting figures relating to the financial side of electric welding. He further showed on the screen the latest developments in machines for the purposes of resistance welding. Both Dr. Paterson and Mr. Wilson displayed some very interesting samples showing the possibilities of electric welding. Mr. F. J. Heyes outlined briefly the work that he had accomplished on "Electric Arc Welding Applied to Aluminium" in the course of a research carried out in the Laboratories of Applied Electricity, the University, Liverpool. The paper was very interesting, and opened up the possibilities of the welding of aluminium. A very interesting discussion followed, in which Messrs. Turney, Malpas, Rettie, Astley, Morton, Collie, Wilson, Harrison, Miller, and Dr. Marchant took part.

SCOTTISH CENTRE.—Conversazione, February 3rd, 1921. Referring to the circular dated November 23rd, 1920, members who have not yet applied for tickets are requested to communicate not later than Wednesday, January 26th, with Mr. R. B. Mitchell, Glasgow Corporation Electricity Department, or Mr. Joseph Taylor, hon. secretary.

Chelmsford Engineering Society.—At a meeting held on January 13th, at the East Anglian Institute of Agriculture, a lecture on "Polyphase Induction Motors" was given by Mr. P. Huggins, of Messrs. Crompton's engineering staff. The lecturer outlined the history of the invention, and Mr. Huggins explained the working of induction motors, illustrating his remarks by a number of lime-light slides. In conclusion, Mr. Huggins acknowledged his thanks to Messrs. Crompton & Co. for kindly giving him permission to illustrate the construction and performance characteristics of their machines. The lecture was then discussed.

Railway Engineers' Conference.—At the meeting of the Railway, Electrical, and Telegraph Engineers' Conference in London, on December 12th, Mr. F. Downes, telegraph engineer, of the Great Northern Railway, was appointed President for the year 1921.

National Association of Supervising Electricians.—On Saturday last week the annual dinner of the Association was held at the Holborn Restaurant; the president, Mr. J. S. Highfield, occupied the chair, and the company numbered some 150 members and guests. After the toast of "The King" had been duly honoured, Mr. Whitley, chairman of the Council, proposed "The President," remarking that if institutions, like nations, deserved the Governments they got, the Association must indeed be one of the most worthy institutions in the country, for its three presidents—Messrs. Dykes, Trotter, and Highfield—were of superlative excellence. Mr. Highfield had occupied that post for three years; at their meetings he was always able to draw upon an extraordinarily wide experience to engage their interest on any subject that came under discussion, and they regarded him with feelings not only of admiration, but of affection. The toast was accorded musical honours with enthusiasm, and Mr. Highfield, responding, expressed his sincere appreciation of the compliment at the hands of so eminent a body of friends. He was glad that they held their president in honour as president; the principle was of fundamental importance to the national interests, that an association of men, for whatever purpose, should choose a leader and follow him with loyalty.

Captain Masters, proposing "The Association," said that though he was not a supervising electrician, at any rate he supervised *The Electrician*, a function which, like theirs, demanded tact and patience. The Association was bound to grow in size and usefulness as the electrical industry developed; it was a kind of institution that was both desirable and necessary. Speculating on the part that would be played by the gentler sex in the future of the industry, he pointed out that there were many women supervising electricians already.

Mr. Revell, in reply, paid a well-deserved tribute to the titanic work that had been done for the Association by Mr. Banister, their hon. secretary, who, unfortunately for the Association, was obliged to retire from the post next month on account of ill-health. The Association was founded for purely educational purposes, but had been compelled by circumstances to enter Trade Unionism; its educational objects, however, would never be lost sight of. In its ranks supervisors and foremen mingled and exchanged experience in the spirit of true fraternity. The Association had had to face much trouble, but bore no ill-feeling against the bodies which had attacked it.

Mr. Windebanke proposed "The Press," to which he offered useful hints for the enlivening of its pages, concluding with a tribute to its impartiality and instructional qualities, and the assistance which it afforded to the profession to which they were all proud to belong. Mr. A. H. Allen, responding, pointed out that the Association was the only one of its kind with which the Electrical Press had never had occasion to differ, and expressed the hope that it would continue to prosper and progress on the lines which it had marked out for itself.

Mr. A. J. Stiling proposed "The Visitors," and incidentally announced that on March 29th the Association would hold a discussion on "Gas *v.* Electricity for Lighting, Heating, and Power," with Mr. Goodenough leading for gas, and Mr. J. W. Beauchamp for electricity. Responding to the toast, Mr. A. W. Wyatt remarked that the Association was founded on the sound principles of altruism and education.

The toasts were interspersed with a well-arranged programme of music and song, and the proceedings were thoroughly enjoyable.

Edinburgh Electrical Society.—The opening meeting of the year was held on January 14th, when Mr. W. F. Mitchell read a paper entitled, "Some Notes on Cables." The author briefly described the development of practice with regard to heavy town mains and distributors. The various methods of insulating were illustrated, and the reasons given for the failures or successes of some of these. The question of v.i.r. cables for direct-current supply was specially considered, and numerous specimens of faults were exhibited. At the close the author replied to a number of questions as to fault localisation and method of jointing, and in the course of his reply referred to the possibilities of having perished rubber or bitumen cables reinsulated with paper or other covering.

Physical Society of London.—On Friday, January 28th, at 5 p.m., at the Imperial College of Science, South Kensington, the following papers will be read:—

"The Magnetic Separation of the Neon Lines and Runge's Rule," by Prof. H. Nagaoka, Imperial University of Tokio.

"A Method of Demonstrating the Retro-active Property of a Triode Oscillator," by Captain E. V. Appleton, M.A., B.Sc., R.E.

"The Quickness of Response of Current to Voltage in a Thermionic Tube," by D. Owen, B.A., D.Sc., and R. N. Archer, B.Sc., M.I.E.E.

Institute of Marine Engineers.—Mr. W. Brooks Sayers, lecturing on electronomy, at the Institute, on January 11th, gave some interesting experiments in support of the theory that varying weather conditions are to be accounted for by the effect on our atmosphere of electro-vaporous streams from the sun. The violent atmospheric disturbances which occur during storms were explained on the basis that these electric streams from the sun charged the higher atmosphere both with water vapour and electricity up to a point at which the disruption discharge known as lightning occurred, or there was a huge, more or less continuous, leak through which the electric fluid passed, and produced tornadoes, whirlwinds, waterspouts, and other violent phenomena.—*Morning Post.*

Paisley Association of Electrical Engineers.—Mr. C. J. Gregg, director (Glasgow Branch) Messrs. Falk, Stadelmann & Co., Ltd., delivered a paper on "The Progress of Lighting," to the Association, on January 12th. The speaker traced the progress of artificial illuminants through various periods. Industrial, domestic, and street lighting were dealt with in their various phases. He contended that employers of labour had not yet been educated to the many advantages to be derived from an efficient lighting system properly applied, and that an improved standard of lighting should be incorporated in the Factory Act; that it was also a matter of immediate concern to insurance companies, and that they should be prepared to allow more favourable rates to factories, workshops, and houses which were considered well lighted.

Barrow and District Association of Engineers.—At a meeting for apprentices, held on January 12th, Mr. J. S. Milner delivered a lecture on "The Manufacture of Jigs and Profile Gauges." Mr. Milner stated that although jigs and gauges were introduced with the object of securing interchangeability of details, the main modern incentive to their use was the cheapening of production. The jig system had lately been applied in foundries for the accurate placing of patterns on moulding machines. This enabled castings to be made in perfect register at a minimum cost. Mr. Milner carefully and clearly explained the machines used and the methods adopted in the manufacture of jigs. The lecture throughout was illustrated by lantern slides, and numerous examples of special tools, jigs, and gauges were exhibited.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

PROF. W. M. THORNTON, head of the Electrical Engineering Department of Armstrong College, Newcastle-on-Tyne, has been ordered complete rest by the doctors. Dr. Thornton's work has been especially heavy recently, owing to the large increase in the number of students studying electrical engineering, and it has been intensified by his continuing certain work begun during the war at the experimental station at Shandon-on-the-Clyde, by the Admiralty. At a meeting of the North-Eastern Centre of the I.E.E., last session, Dr. Thornton gave some interesting particulars as to the work that had been carried out at Shandon and elsewhere in the matter of under-water signalling.

Exeter Town Council is recommended to increase the salary of the electrical engineer, MR. H. D. MUNRO, from £700 to £760, as from October 1st last. The pre-war salary was £475.

MR. A. P. RUTHERFORD, late borough engineer at Leith, has claimed from the Edinburgh Town Council, owing to the amalgamation of Leith with the city, a capital sum of £500 as compensation for loss of office.

MR. W. G. WATSON is returning to Australia on January 29th. His London address is c/o Messrs. Coombs and Richards, 150, Southampton Row, London, W.C. 1.

MR. E. A. UTTLEY, M.I.E.E., M.I.Mech.E., and Mrs. Uttley returned to South Africa last Friday en route for Rhodesia, where Mr. Uttley will resume his post with the Government as Chief Construction and Electric Inspector. He volunteered for war service in 1917, and was appointed to the Ministry of Munitions; he has been with the Admiralty for the last three years as an electrical engineer at H.M. Dockyard, Portsmouth.

Members of the electricity department of the Rhondda Urban Council, at their annual dinner at Pontypridd on Saturday, presented MR. H. H. REED, the chief clerk, with a cruet stand. The gift was handed to him by Mr. Mark Harcombe, chairman of the Gas and Electricity Committee.

Burton-on-Trent Town Council has increased the salary of the borough electrical engineer by £250 a year, making £900 a year.

MR. W. M. ACWORTH, on whom the King has authorised the Viceroy of India to confer the honour of Knight Bachelor, was a member of the Royal Commission of Inquiry into Canadian Railways, 1916, and is a director of the Underground Electric Railways of London, and other companies.

COUNCILLOR H. W. WALE, who has been three years chairman of the Electric Tramways Committee of the Coventry Corporation, has been presented by the staff and employés with an illuminated address and a silver cigarette case. The presentation was made by the general manager, Mr. T. R. Whitehead.

Obituary.—MR. ROBERT MCLEAN.—We regret to record that Mr. R. McLean, for 20 years manager and engineer of the Guernsey States Telephone Department, died suddenly on December 30th. Mr. McLean, who was well known in telephone circles, was born in 1869 at Musselburgh. He was apprenticed to the National Telephone Co. at Edinburgh in 1885; became chief inspector to the Mutual Telephone Co., Manchester, in 1890; chief inspector to the New Telephone Co., London, in 1892; local manager with the National Telephone Co. at Cardiff and elsewhere in 1894; and was appointed to Guernsey in 1900. Under his care the Guernsey Telephone System increased from 679 stations in 1900 to 2,700 at the end of 1920, and obtained a reputation for good and economical service and administration.

Wills.—The late MR. GEORGE TANGYE, chairman of Tangye, Ltd. left £207,137, net personalty £172,319.

The late MR. FRANCIS INCE, a director of the Electrical Standardising and Training Institution, left £79,858 gross and £69,457 net.

NEW COMPANIES REGISTERED.

Electric Lamp and Bulb Co., Ltd. (172,518).—Private company. Registered January 10th. Capital, £100 in £1 shares. To carry on the business of electrical manufacturers, supply agents and wholesale and retail factors, electrical engineers and contractors, manufacturers of glassware of all kinds, &c. The first directors are: F. Kitchener, 25, Boileau Road, Ealing, W. 5; A. H. Greening, 15, Cliffords Inn, E.C. 4. Registered office: 15, Cliffords Inn, E.C.

Elco Electric Manufacturing Co., Ltd. (172,517).—Private company. Registered January 10th. Capital, £12,000 in £1 shares. To take over the business of a manufacturer, factor and repairer of switchboards, control panels, starters and electrical appliances carried on by A. C. Wiley, at Colston Yard, Colston Street, Bristol, as the "Elco Electric Manufacturing Co." The first directors are: A. C. Wiley (chairman and managing director), Wansdyke, Portbury, Somerset; W. F. Cook, no address stated; F. W. Fifield, 30, Whiteladies Road, Clifton, Bristol. Registered office: 9, Denmark Street, Bristol.

E. A. Ingold, Ltd. (172,591).—Private company. Registered January 14th. Capital, £2,000 in £1 shares. To take over the business of an electrical engineer, factor and agent carried on by E. A. Ingold at 17, East Parade, Leeds. The first directors are: E. A. Ingold, 22, Cedar Grove, Wortley, Leeds; J. M. H. Hoffman, Prospect House, Oak Lane, Bradford (both permanent, subject to holding 500 shares each, with £50 each per annum as remuneration). Solicitor: G. F. Hart, 26, Bond Street, Leeds. Registered office: 17, East Parade, Leeds.

Miriograph Co., Ltd. (172,524).—Private company. Registered January 10th. Capital, £1,500 in 20,000 ordinary shares of 1s. each and 500 10 per cent. preference shares of £1 each. To carry on the business of advertising sign manufacturers and agents, &c. The subscribers (each with one share) are: F. Bindley, 4, Mitre Court, Temple, E.C., solicitor; P. J. Powell, 4, Mitre Court, Temple, E.C., clerk. The first directors are: F. G. Carter (managing director), P. Rowley, Capt. J. C. W. Anderson, G. Udal, and H. Sutton. Registered office: Regent House, Regent Street, W.

White, Andrews & Co., Ltd. (172,586).—Private company. Registered January 13th. Capital, £10,000 in £1 shares. To carry on the business of electrical and general engineers, founders, smiths, machinists, &c., and to adopt an agreement with A. E. White, H. G. Andrews, senr., and H. G. Andrews, junr. The permanent directors are: H. G. Andrews, senr. (chairman), 73, High Street, Reigate; H. G. Andrews, junr., 73, High Street, Reigate; A. E. White, 52, Totterdown Street, Tooting, S.W.; G. F. Bennett, North Villa, Elgin, N.B. The two last named are joint managing directors. Secretary: H. G. Andrews, junr. Registered office: 9-10, Water Lane, Ludgate Hill, E.C. 4.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Metal Industries, Ltd.—Charge on the whole of the company's property, dated December 15th, 1920, to secure £100 and further advances. Holder: Sir Wilfred Stokes, K.B.E., 32, Victoria Street, Westminster.

Leatherhead & District Electricity Co., Ltd.—Particulars of debentures authorised December 20th for an unlimited amount, but not to exceed the amount of the issued capital for the time being, and covered by trust deed dated December 28th, 1920, present issue £34,200, charged on freehold land and hereditaments at Fetcham, Surrey, and the company's undertaking and property, present and future, including uncalled capital. Trustees: P. P. Ralli and J. W. Chalkley.

Norwegian Electric Smelting Co., Ltd.—Declaration of trust and deed of indemnity dated December 30th, 1920, to secure all moneys payable, under a contract referred to therein, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: H. H. Blackburn, 24, Bank Street, Bradford.

James Keith & Blackman Co., Ltd.—Satisfaction in full on December 7th, 1920, of debentures dated October 29th, 1901, securing £300.

Quead, Ltd.—Particulars of £5,000 debentures authorised October 30th, 1920, whole amount issued. Charged on the company's undertaking and property, present and future, including uncalled capital.

Electrical Contracts and Maintenance Co., Ltd.—Satisfaction in full on December 6th, 1920, of debenture dated February 12th, 1918, securing £13,000.

Semco, Ltd.—Mortgage dated December 3rd, 1920, to secure £800, charged on 440a, Romford Road, Forest Gate, E., and right of way. Holders: Misses M. A. and R. Baines, 124, Station Road, Wood Green; and Sir John H. Bethell, Bt., Bushey House, Bushey, Herts.

Yorkshire Cable Co., Ltd.—Satisfaction in full on December 23rd, 1920, of debenture dated December 10th, 1917, securing £4,000.

Brecknell, Munro & Rogers, Ltd.—Satisfaction in full on August 12th, 1920, of debenture dated September 1st, 1919, securing all moneys or liabilities then due or to become due.

A. L. Brown & Co., Ltd.—Debenture dated December 17th, 1920, to secure £225, charged on company's property, present and future, including uncalled capital. Holder: Rev. S. E. Ward, Eldon House, Lower Bourne, Farnham, Surrey.

Musselburgh and District Electric Light and Traction Co., Ltd.—Satisfaction to the extent of £1,300, on December 20th, 1920, of charges dated November 13th, 1905, and May 11th, 1909, securing £90,000.

CITY NOTES.

The Edison Swan Electric Co., Ltd.

Presiding at the ordinary general meeting on Monday last, Mr. Charles J. Ford said it would be noted with satisfaction that the debenture stock sinking fund was gradually increasing, although it had only been in operation about two years. At the date of the balance sheet, under the operation of the fund, they had set aside a total amount of over £23,000, with which stock had been redeemed to the nominal amount of over £29,000; the stock having been purchased at a discount. In addition to that amount there had been purchased, in anticipation of the requirements of the sinking fund, £18,184 stock, at a cost of £14,620, making a total of both classes of stock purchased to date of £47,278, at a cost of £37,620. Sundry creditors and credit balances appeared at a figure of over £240,000 more than they did last year, and their liability on loans had largely increased. The amount of investments, standing at over £77,000, had also been very largely increased, and included an interest amounting to £50,000 in the Enfield Ediswan Cable Works, Ltd., and £25,000 in the Brotherton Ediswan Tubes & Conduits, Ltd. Freehold and leasehold property had been increased by over £78,000, and plant and machinery to the extent of about £48,000. Stocks, including work in progress, and sundry debtors, had also very largely increased. About a year ago they entered into an arrangement with the Philips Glowlampworks, Ltd., of Eindhoven, Holland. The Philips Co. possessed methods, processes, and novel labour-saving plant far in advance of that in the works of other manufacturers. They were now turning out lamps, particularly gasfilled, in large quantities, equal in every respect to those manufactured by Messrs. Philips in Holland, and they were obtaining a ready sale for them. That could not be carried out without the expenditure of a large amount of capital, far more in fact than it was possible to provide out of their own resources. They therefore made an arrangement with Messrs. Philips for the formation of a new company, to be called The Ediswan Lampworks, Ltd., the capital being provided in equal shares by Messrs. Philips and the Edison Swan Co. Under that arrangement their lampworks would be leased to the new company, except that portion of them which they had recently erected, together with the machinery and plant thereon. The last would be sold to the new lampworks; at the same time the new company would take over from them certain stocks and raw materials. The outcome of that arrangement would be that they would not have to put up any cash, the whole being provided by Messrs. Philips. The increased capacity of the factory to turn out lamps on a more economical basis would doubtless help the company to bear the higher charges for wages, and provided there was no material falling-off in the demand for their lamps, he was satisfied they would be able to show satisfactory profits in future, in spite of the increased wages bill. The shareholders were aware that they had entered into arrangements with the Sangamo Electric Co. of the United States to co-operate with that company in the production of all classes of electric meters at their Ponders End works. They had erected buildings there which were now being equipped with the necessary plant and machinery, capable of turning out those articles on a large scale, and they believed from the support which they had already received that they would readily dispose of the whole of the output. When they looked at the very great increase in the turnover which had taken place, they would see that the capital did not bear a reasonable proportion to the expansion of the business and the higher costs of production. The solution of the difficulty was additional capital, but at the present moment it was wholly impossible to provide that. In the absence of further capital it had become absolutely necessary to husband their cash resources, and although a substantial profit had been earned, it would have been a suicidal policy to dip into those resources in the payment of even a dividend of, say, 5 per cent., which would absorb about £50,000. If they could without prejudice to the position, see their way to pay an interim dividend before the end of the financial year at June 30th next, they would do so. The business of the company was proceeding satisfactorily; the sales were increasing, and up to the present they had not been affected by foreign competition.

Replying to a short discussion, the chairman said the board could not be held responsible if gentlemen bought the shares of the company at a high price on rumours of amalgamation or absorption by another company. The Enfield and Brotherton Tube Companies were perfectly good investments. They got large dividends from them, but they did not go into those companies as investors, but as manufacturers, and it had been a very satisfactory arrangement. With regard to the export trade, they were doing as much business in that direction as it was possible for them to do. They had three branches in Australia, and they did a very big business there; and the same remark applied to India and South Africa.

The report was then agreed to.

Subsequently an extraordinary general meeting was held, at which a resolution was passed authorising the creation of additional capital by the board from time to time, the chairman explaining that the board did not intend to make any issue of capital on any terms until they had first called the shareholders together and received their authorisation.

New Issues.—*W. T. Henley's Telegraph Works Co., Ltd.*, is issuing 250,000 ordinary shares of £1 each at the price of 24s. per share. The shares will rank for dividend as from January 1st, 1921, but will not participate in the final dividend which will be paid for 1920. Applications from shareholders and debenture stock holders of the company will receive preferential treatment. The prospectus states that the new capital is required to finance increased business and to provide for additions to the works to meet future demands. The list closes on January 25th.

Tramways, Light & Power Co.—The British Trusts Association is offering £200,000 8 per cent. five-year notes at 95½. The notes are part of a total amount of £375,000 authorised, and are redeemable at £106 on January 7th, 1926.

Stock Exchange Notices.—The following have been ordered to be officially quoted :—

Anglo-Portuguese Telephone Co., Ltd.—£50,000 5 per cent extension debenture stock.

Liverpool Overhead Railway Co.—Final dividend of 1¾ per cent. on the ordinary shares, making 3 per cent., less tax, for the year ended December 6th.

J. G. White & Co., Ltd.—The net profit for 1920 (according to the *Financial Times*) was £28,100. Dividend 7 per cent. on both classes of capital. £30,000 to reserve.

Lima Light, Power & Tramways Co.—Dividend of 2 per cent.

STOCKS AND SHARES.

TUESDAY EVENING.

INVESTMENT stocks show the greatest amount of strength in the markets of the Stock Exchange. The volume of business in purely investment securities forms the chief part of Stock Exchange work to-day. In other words, speculation is dormant; indeed, is nearly dead in most of the areas which used to be regarded as favourite gambling grounds of the public. But money accumulates. There is still plenty of capital seeking investment in Stock Exchange circles. By steady degrees, the amount of debenture stocks which was available for purchasers a month ago is being reduced. The stream of new issues runs more slowly than it has been doing of late, but there are several new flotations said to be pending, of which some at least are on behalf of Colonial electric corporations. Stock Exchange betting runs strongly in favour of a reduction in the Bank Rate this week.

The way in which the value of the pound sterling is increasing, in comparison with that of the dollar, has brought about further falls in the prices of dollar securities, amongst them the issues of utility companies working in Canada, the United States, South America, Japan, and elsewhere. As things are, however, the exchange is still sufficiently disgruntled to make the difference between parity prices in this country, and those which rule in the American markets, to be extremely pronounced. People who continue to keep alive the business of buying and selling between this country and the other side of the Atlantic are frankly sceptical about any real revival of interest until such time as the quotations in the two continents can be brought into much closer correspondence with each other than is possible at present. The position is, of course, that American stock, say of an electric lighting or telephone concern, is priced very much higher in this country than it is in New York, the difference arising simply from the rate of exchange. The British capitalist, however favourably inclined he may be toward the American investment, fights shy of giving so very much more in London than he would be asked to pay in New York, although the actual amount of money required in both cases would be the same, measured in terms of pound sterling and dollars. Were an Export Credit scheme to be established, upon which a good many hopes are centring now, it is a reasonable assumption that something of the same kind would be attempted between this country and the United States, but until this comes about, arbitrage business in Stock Exchange securities is bound to continue restricted.

Radio Corporations of both classes have given way, the common to 9s. and the preferred to 11s., for which the reason seems to be a decline in Marconis to 2¼. The market lately has been a dull one, with no particular interest taken in it, and since the dividend disappointment, a continuous selling movement has been on foot. Marconi preferences have eased off to 2, and the other Marconi shares are heavy.

At the meeting of the Edison-Swan Company on Monday, the Chairman practically denied that there was anything in the nature of any amalgamation on foot with another company. The price of the shares is unchanged at 12s. 6d. Metropolitan-Vickers preference have been a good spot, with a sharp rise to 40s., the ordinary improving also at the same time to 20s.; the buying is said to be traceable to Birmingham. Vickers, however, have given way a little, and other armament issues, together with those of the iron, coal and steel group generally, are lower owing to the closing down of various works in the country, and to the difficulties presented to traders and workmen alike. Babcock & Wilcox have risen to 2 5/16. British Insulated are a good market at 32s. 6d., Siemens are better at 21s. 3d., and Telegraph Constructions have gained 10s. at 21½. Henley's are unchanged at 30s. The company is making a new issue of 250,000 ordinary shares of £1 each at 24s. per share, to rank for dividend as from January 1st this year, but not to participate in the ordinary dividend which will be paid for 1920. Applications from shareholders and debenture holders of the company will receive preferential consideration. It will not be surprising if some of the holders of the existing shares were to sell these in order to apply for the new issue. General Electric preference are a little better at 18s., and the ordinary at 24s. 4½d. English Electric Notes are firm at 94½, and Westinghouse Brake debenture stock hardened to 96.

The Eastern Telegraph group has again strengthened, and the usual procession of rises is shown in Westerns, Easterns, Globe ordinary and Eastern Extensions. Investors on the lookout for safety and six per cent. are taking up these stocks, with the knowledge that to these advantages is added the further benefit of the dividends being paid free of tax on the ordinary shares. Great Northern Telegraphs have risen to 20½. The Anglo-American group is quiet, and there is not much doing in other telegraphs or telephones.

Tube railway stocks are better, with rises in the three issues of the Underground Electric Company and in Metropolitan ordinary. The dividend declaration on the latter will be out this week. It cannot be said, however, that the railway market as a whole is in a satisfactory state. The claim of Mr. J. H. Thomas, on behalf of the workmen, that the latter should be given a share in the management of the companies is not read as a bull point, and the prices of the steam stocks are disposed to sag. The Underground Companies will announce their dividends on February 3rd. In the foreign group, Brazil Tractions are better at 39, and the preferred shares rose to 77½.

Westminster Electric ordinary have recovered to their par price of 5, and County of London preference at 7⅞ regained half their loss of last week. City of London ordinary are also better at 23s. 1½d. Canadian General Electric ordinary shares at 110 and the preferred at 101½ are both better than they have been of late. British Electric Transformer preference rallied to 13s. 9d. British Electric Traction 5 per cent. debenture stock at 60 is 2 points higher. Adelaide Electric Supply preference gave way to 17s. No importance need be attached to the humorist's effort to connect this with the result of the Test matches. The market in rubber shares is stagnant, and after their recent premature rush-up, prices of most of the leading shares show a tendency to ease off again.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Jan. 18 1921.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	8½	—	£12 4 4
Charing Cross Ordinary	4	7	3½	—	10 0 0
do. do. do. 4½ Pref.	4½	4½	2⅞	—	8 8 8
Chelsea	3	4	3½	—	6 8 9
City of London	8	10	1⅞	+ 1/16	8 12 9
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7½	—	10 18 4
do. do. 6 per cent. Pref.	6	6	7⅞	+ ⅛	7 15 0
Kensington Ordinary	6	7	5½	—	9 0 6
London Electric	Nil	2½	1	—	10 0 0
do. do. 6 per cent. Pref.	6	6	2⅞	—	10 18 9
Metropolitan	5	6	2⅞	—	10 18 2
do. 4½ per cent. Pref.	4½	4½	2⅞	—	8 15 8
St. James' and Pall Mall	10	12	6½	—	9 12 0
South London	5	6	2¾	—	9 12 8
South Metropolitan Pref.	7	7	13/9	—	10 8 8
Westminster Ordinary	8	10	5	+ ⅛	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	75½xd	+ 1	† 7 19 0
do. Def.	88/6	1½	15xd	—	10 0 0
Chile Telephone	8	8	5½xd	—	†5 4 4
Cuba Sub. Ord.	7	7	6½	—	†10 7 4
Eastern Extension	8	10	154xd	+ 1½	†8 13 8
Eastern Tel. Ord.	8	10	154xd	+ 2½	†6 9 5
Globe Tel. and T. Ord.	8	10	15½	+ ½	†6 12 3
do. do. Pref.	6	6	8½	—	† 7 1 2
Great Northern Tel.	22	22	20½	—	† 10 14 8
Indo-European	18	10	80	—	† 6 6 8
Marconi	25	25	2¼	— ⅛	—
Oriental Telephone Ord.	10	12	2⅞	—	†5 4 0
United R. Plate Tel.	8	8	5½	—	†8 16 4
West India and Panama	1/8	Nil	⅞	—	Nil
Western Telegraph	8	10	15½	+ ½	†6 12 3
HOME RAILS.					
Central London Ord. Assented	4	4	43½	—	† 9 4 8
Metropolitan	1	1½	20½	+ ½	† 5 2 0
do. District	Nil	Nil	15½	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	+ ⅛	Nil
do. do. "A"	Nil	Nil	6	- 6d.	Nil
do. do. Income	5	4	68½	+1	—
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref.	Nil	5½	22 xd	—	† 10 0 0
do. do. 2nd Pref.	Nil	Nil	8½	+ ½	Nil
do. do. 5 % Deb.	5	5	67½	+2	† 8 17 0
Brazil Tractions	Nil	Nil	39	+1	Nil
British Columbia Elec. Rly. Pfce.	5	5	55xd	—	† 9 1 10
do. do. Preferred	2½	5	54½	—	†8 9 9
do. do. Deferred	Nil	3	54½	—	†11 8 4
do. do. Deb.	4½	4½	64½	—	† 7 16 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	38	+1	Nil
do. 6 per cent. Bonds	Nil	Nil	22½	—	Nil
Mexican Light Common	Nil	Nil	12⅞	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds	Nil	Nil	69½	+3	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15 —	2⅜	— 1/16	†6 10 4
British Aluminium Ord.	10	10	1⅞	—	11 8 6
British Insulated Ord.	12½	15	1½	+ ⅛	9 5 10
Callenders	25	15	1½	—	10 18 2
,, 6½ Pref.	6½	6½	17/6	—	7 8 7
Castner-Kellner	20	17	2⅞	—	† 7 12 9
Crompton Ord.	10	10	15/9	- 9d.	† 3 14 0
Edison-Swan	10	10	12/6	—	—
do. do. 5 per cent. Deb.	5	5	70	—	† 7 2 10
Electric Construction	10	10	⅝	—	11 8 6
Gen. Elec. Pref.	6½	6½	18/-	+6d.	† 7 4 5
do. Ord.	10	10	1⅞	+ 1/16	†8 4 8
Henley	25	15	1½	—	10 0 0
do. 4½ Pref.	4½	4½	8½	—	† 7 4 0
India-Rubber	10	10	⅞	—	—
Met.-Vickers Pref.	—	8	2	+ ½	† 8 0 0
Siemens Ord.	10	10	1⅞	+ 1/16	†2 8 2
Telegraph Con.	30	30	21½	+ ½	†6 11 6

† Dividends paid free of Income Tax.

THE USE OF BALL BEARINGS IN ELECTRIC MOTORS.

(COMMUNICATED.)

Only a few years ago ball bearings on electric motors were almost unknown; to-day their use is a matter of general practice. Apart from the realisation of their advantages that has resulted from experience, the sudden demand is to a certain extent due to the advances that have recently been made in the construction of the bearings themselves. The fine material used in the manufacture of modern ball bearings, and the extreme accuracy which distinguishes the construction of those of the highest class, have resulted in an article superior to the ring-oiled bearing, not only as regards its coefficient of friction, but also in reliability; and the last argument against the ball bearing has thus been answered. Modern ball bearings have, in fact, proved to add very considerably to the reliability of the motors in which they have been incorporated, while greatly increasing their efficiency and economy. While the suitability of the ball bearing for electric motor applications is generally accepted by the larger manufacturers in this country, there are still some who adhere to the policy of fitting ring-oiled or waste-packed bearings, particularly in the manufacture of very small or very large motors. In most cases, no doubt, the maker is deterred from the use of ball bearings by their initial cost, and the consequent necessity of raising the price of the motor. With the object of showing that the substitution of ball for plain bearings not only justifies the extra expense, but actually increases the selling power of the motor, the following summary of the advantages accruing from such a change has been compiled.

Cost.—To begin with, the charge made against the ball bearing that it is expensive requires investigation, because if a careful estimate of the cost involved in the two cases be made, the difference will be found to be very slight, if any at all.

In the first place, the plain ring-oiled bearing uses more material and more costly patterns, and involves a considerable amount of labour in scraping the bearings. The ball-bearing housing, on the other hand, is perfectly simple, smaller in size, and no time whatever need be spent in the fitting of the bearing, which is a self-contained unit, and simply slips into the housing. Users will, therefore, be well advised to carry out this comparison before making assertions on the subject.

Maintained Air Gap.—Accuracy and freedom from wear are among the most notable features of the ball bearing. The consequent retention of adjustment keeps the rotor in the centre of the magnetic field, and permits the manufacturer to employ small air-gap clearances that would be out of the question in a motor running on plain bearings. In induction motors a small air gap is of vital importance to the efficiency and power factor of the machine. It is one of the chief drawbacks connected with plain bearings, that after a time they wear down to an extent dependent on loads and conditions of service. If the wear is allowed to continue, the armature will finally come into contact with the pole pieces, and stripping of the armature will probably result. With a ball bearing, in which rolling is substituted for rubbing friction, wear is negligible, and a breakdown such as the above could never occur.

Improved Commutation.—On direct-current machines the ball-bearing feature of lubricant retention is of the utmost importance. Ball-bearing housings are sealed so as to prevent the escape of lubricant, and the commutator is thus kept clean; fouling of the commutator by an accumulation of conducting dust and oil is rendered impossible, and commutation is consequently improved. The precision and durability of bearing setting also results in better commutation. The resulting freedom from sparks from the commutator is of great importance in coal mines, flour mills, woodworking shops, and wherever combustible dust is met with, since the danger of fire or explosion is materially decreased.

Comparative Efficiency.—On motors in which the shaft is subject principally to torque strains, the bearing friction forms a comparatively small percentage of the power losses. This is the case with direct-coupled units, centrifugal pumps, motor-generator sets, &c. The bearings have nothing but the weight of the rotor to carry, and bearing friction is consequently inconsiderable. Where the shaft is subject to bending action, however, bearing friction becomes an important consideration. This is the case with belt- or gear-driven motors, whose bearings are subject to severe bending or shock strains, especially at the driving end. Self-aligning ball bearings here show a decided saving over plain bearings. This will be conceded when it is considered that the coefficient of friction in the double-row, self-aligning ball bearing is about 0.001, and constant under all conditions, whereas the friction in the plain bearing may vary according to the intensity of pressure, running conditions, and even materials used. A smaller motor can frequently be used where ball bearings are applied, on account of the reduced starting effort.

Compactness.—Compactness is usually a consideration of some importance in the conditions governing the industrial use of induction and direct-current motors; as a result, manufacturers develop the greatest possible horse power from a given size of motor frame. The length of the bearings affects the compactness of the whole unit to an important degree. Babbited bearings are usually designed on the principle of using a bearing length of 2½ times the diameter of the shaft they support. The length of a ball bearing, on the other hand, is usually not more than half the shaft diameter. Surrounding the ball bearing is the lubricant chamber, whose overall length is anything from ⅓ to ½ shorter than the plain bearing for the same motor. As a result, the overall length of the whole motor can be reduced by from 10 to 27 per cent. by the use of ball bearings. When a consideration of floor space or machine arrangement arises, a ball-bearing motor is thus of considerable help in solving the problem.

Simplicity and Cleanliness.—The use of ball bearings reduces head construction to absolute simplicity. Instead of oil rings, wicks, waste packing, chains, and other devices necessitated by the use of plain bearings, ball bearings require no oiling devices whatever. They do away with the need for constant inspection, frequent renewal of lubricant, and occasional rebabbiting, and need no other attention than periodical lubrication. The latter is necessary at intervals of from one week to six months, according to service conditions. Cleanliness is assured by fitting the bearing heads with sealing grooves, and the danger of goods becoming soiled or contaminated by oil is no longer present.

Gear-driven Motors.—Wherever a gear drive is employed, ball bearings are of particular advantage. If gears are to run smoothly and quietly, the proper distance between pinion and gear centres must be maintained. Wear in plain bearings is often responsible for noisy, chattering gears, but ball bearings, which show no appreciable wear after long service, ensure accurate mesh and consequent good service on the part of the gears. Ball bearings are designed for high speeds and heavy loads. Their housings are short, and the motor on which they are used may be made very compact. Because of this compact construction the distance between the bearing and the pinion can be decreased, and the overhung load on the bearing proportionately reduced.

The Lubrication Problem.—Ball bearings offer the user of the electric motor the simplest possible solution of the lubrication problem. The ball bearings are contained in simply constructed head brackets which are sealed at both sides and by end caps. These end caps are fitted close to the motor shaft, and are proof against leakage of lubricant as well as against the intrusion of moisture, grit, and other foreign substances. The ball cage, or retainer, is of such construction that the bearings are open at the sides, and free circulation of the lubricant in the ball paths is thus assured.

THE DISTRIBUTION OF ELECTRICITY.

DISCUSSION AT LIVERPOOL.

AT the eighth ordinary meeting of the LIVERPOOL SUB-CENTRE of the NORTH-WESTERN CENTRE of the I.E.E., Mr. W. B. Woodhouse's paper on the above subject, which was abstracted in our issue of December 3rd, and Mr. R. O. Kapp's paper on "Some Economic Aspects of e.h.p. Distribution by Underground Cable," which was abstracted in our issue of December 17th, were discussed together on December 13th.

Mr. WELBOURN noted that Mr. Kapp took as his basis 33,000 volts for transmission and 6,600 volts for detail distribution; Mr. Woodhouse, on the other hand, took 11,000 volts for his detail distribution, and the speaker wondered whether they ought not to invite them to discuss what the detail distribution should be. He could not help thinking that those gentlemen had specific cases in their minds rather than the general case, and they were recommending what they found the right pressure for their particular case. Mr. Kapp laid it down as fundamental that they must have one spare cable, but surely that could not be a general rule. If they had a cable supply into a consumer's premises one spare cable gave a duplicate supply, but if a supply to a sub-station required six or eight cables it surely could not be right to have one spare cable. With the modern cable at 6,600 volts, the overload capacity would be quite sufficient during the time one broken down cable was out of commission. Mr. Kapp said: "It is very doubtful indeed if engineers will decide in future schemes that the advantages of cable protective gear are great enough to justify its cost," but that seemed to him to be quite a fundamental difference, and if he understood Mr. Woodhouse's paper on that subject, he advocated wholeheartedly the necessity for some protective gear, especially in those cases where they had an interconnected network. On some of the large networks in this country it had been found an absolute *sine qua non* that they should have instantaneous protective gear so that in the event of a fault between phases, or to earth, the line should be automatically disconnected before any synchronous motor could fall out of step. Mr. Kapp's contribution to the subject of cable temperatures was one of the most helpful he had seen. Mr. Woodhouse's expression for the current-carrying capacity of 11,000-volt armoured cable laid direct in the ground was an entirely arbitrary expression, and did not convey very much unless they were told the continuous copper temperature he was considering. The total operating experience of the world with 33,000-volt cable was limited to some 50 miles of cable, if his information was correct. It seemed to him rather unwise and opposed to British conservative methods to talk of jumping wholesale from 33,000 to 66,000 volts without having a great deal more experience, which could only come from extended knowledge of the behaviour of compound dielectrics under continued stress over a period of years under operating conditions.

Mr. J. A. MORTON wanted to know how Mr. Kapp arrived at his statement that "the capital charges on the e.h.t. distribution system of a super-power scheme will be comparable with the coal bill and may even exceed it." He did not think such capital charges could ever come near the cost of the coal bill; if the figure was one-third he thought it would be nearer the mark. Later on he said "the average charge per unit may be as low as about 0.05d. or as high as about 0.22d. to cover the capital charges alone on e.h.t. distribution." From his (the speaker's) figures he thought the capital charges ought really to be about half what Mr. Kapp mentioned. The lack of taking feeder loss into account in Mr. Kapp's paper made one feel that one would have to use the figures, &c., which he put down, very carefully. Mr. Woodhouse pointed out that those losses were a very important part of the transmission of energy, just as important as the capital cost which Mr. Kapp dealt with, and he would probably find that if those losses were taken into account he would come to different conclusions on several points. With regard to "the most economical position of a sub-station," a method which was sometimes used was to let l_1 l_2 l_3, &c., represent the individual loads, and x_1, x_2 x_3, &c., and y_1 y_2 y_3, &c., represent the distances of those loads from any two fixed lines OX and OY at right angles to each other. Then the "sub-station position" was that point which was the distance

$(x_1 l_1 + x_2 l_2 + x_3 l_3$, &c.$)/(l_1 + l_2 + l_3$, &c., (from OX, and) $y_1 l_1 + y_2 l_2 + y_3 l_3$, &c.$)/(l_1 + l_2 + l_3$, &c.,) from OY.

Personally, he thought that method was near enough, and he mentioned it because Mr. Kapp said he had not met with any other method of doing it except by that ingenious string method which was a very good one, and would be very useful. Mr. Kapp decided on economical voltage purely from the point of view of capital cost. If he had taken the *annual* total costs into consideration he would have probably found it would pay to use 30,000 volts at a less distance. He thought Mr. Kapp had an inkling of that because he mentioned that he would be inclined to adopt that pressure for less distance. A rather extraordinary statement, to his mind, was that he believed "that 0.075 cq. in., or some figure near to it, will in future become the standard cross section on 6,600-volt networks, with possibly feeders of some smaller cross section on the outer fringe of the supply area." For instance, there was a distinct saving in capital cost by the use of one .25 cable instead of two .075 cables; in one case it was £1.045 per kVA per mile laid, and the other £0.93. If the annual I^2R losses had also been taken into account and added to the capital cost, the comparison would be still more in favour of the one .25 cable. His experience in cables suggested that wherever possible they could use one cable up to .3 sq. in. for economy rather than two smaller ones, such as suggested by Mr. Kapp. Mr. Woodhouse mentioned the fact that "the load factor of the losses was less than that of the load, and that allowance ought to be made in the cost of the waste energy on account of this." Another similar point was that the annual charges on the increased size of main to transmit the losses ought also to be taken into account. When they took those into account they might get the cost of wasted energy in a cable 30 per cent. more than the actual cost at the power station. Dealing with the economic pressure, he did not think there were any simple formulæ of the Kelvin's law pattern which could deal with that question in a simple, straightforward way, especially when they were dealing with e.h.t. transmission. For overhead lines, Prof. Still gave a rough formula for the voltage for lines over 20 miles long, and the economic voltage (kV) was $5.5 \sqrt{\text{miles}}$ kW/100. He had found that useful for overhead work, but not for underground cables. Mr. Woodhouse stated that the extra cost involved by an increased size of conductor forming part of a cable laid direct in the ground did vary in strict proportion to the weight of metal. He (the speaker) did not think that was so. For instance, taking a .04 l.t. 3-core and a .25 l.t. 3-core cable, the metal cost varied as 1: 6.65, while the cost of insulation and lead, &c., varied as 1: 2.65, while with the same sizes of 6,600-volt armoured cable the cost of insulation, &c., varied as 1: 1.3. It was such things which made it difficult to use simple formulæ for cable work. Mr. Woodhouse mentioned many modifying influences which spoiled the simple beauty of those formulæ. They took no account of the dielectric losses which went on all the time whether a cable was carrying a load or not. Those losses might even be the governing factor, being very considerable in some cases, such as in, say, a ten or 20-mile transmission of 12,000 kW as between 30,000 and 60,000 volts, because in that case the dielectric loss in a 60,000-volt cable at 40 per cent. l.f. would be more than the I^2R loss, and although the dielectric losses cost less than the I^2R losses, having 100 per cent. load factor, yet when they were taken into account they put a different aspect on matters in the case of bulk transmission where heavy loads had to be taken over a considerable distance. Another point was that the power factor of such e.h.t. cables rose with the pressure so that the dielectric losses did not vary as the square of the pressure, but as something more. The power factor of a 30,000-volt cable would be less than one for 60,000 volts, though no one knew much about 60,000-volt cable yet. Those were points which had to be taken into account, and made an important difference in arriving at the most economical size and voltage. For bulk supply, he found, working on dielectric losses which a cable maker might be expected to get, and taking costs of switchgear, &c., into account, that generally speaking, if the load was not too great for one cable to carry then a 30,000-volt cable was equally if not more economical than a 60,000-volt cable up to 20 miles run, and the risk was less. One could lose a lot of money in dielectric losses. He wished personally that instead of having to qualify all those nice equations, someone would invent a high voltage d.c. system so that they could apply Kelvin's law in its pristine simplicity without any tomfoolery. Mr. Woodhouse suggested that by his equations they could ascertain economic size and pressure, but his experience was that they could not; it was usually only by laborious processes tried upon different cables that a man could arrive at what was the economic pressure. When they came to really high pressures they had to consider other matters besides I^2R losses and capital charges —they had their transformer losses and the extra risk, a very important thing which could not be expressed in £ s. d.

Mr. NISBETT said that both papers were particularly appropriate, because a fashion had set in for the concentration of large amounts of power into one central station, with consequent increase of the area supplied from one source, and in his opinion it was being rather run to death without counting the cost or even proper investigation concerning the cheapest way in which the district could be supplied. In order partly to justify such super-schemes, and to cut the capital charges, engineers were calling on the cable makers for higher and higher pressures, and were willing to accept super-tension cables with a very much lower factor of safety than anything yet employed. A huge experiment was being tried and dielectric stresses were being imposed vastly in excess of those of which they had any experience. For instance, taking for comparison a 0.10 sq. in., 3-core cable built to B.E.S. specification:—

3,300-V cable had a maximum stress of 834 V per mm.
6,600-V cable had a maximum stress of 1,348 V per mm.
11,000-V cable had a maximum stress of 1,753 V per mm.

Now in the case of super-tension cables not standardised, but built to the dielectric thickness commonly employed:—

22,000-V cable had a maximum stress of 2,950 V per mm.
33,000-V cable had a maximum stress of 3,880 V per mm.
66,000-V cable had a maximum stress of 6,150 V per mm.

It might be that with good luck these highly stressed cables would be all right, but only years of use could prove if it

was so or not. Meanwhile, in any comparison of cost between cables working at one pressure or another the difference in the safety provided must be kept in mind. Mr. Woodhouse's cable cost curves, fig. 1, were totally misleading. In the first place, he had used some 1907 prices, while others were up-to-date; for even an approximate comparison the three lower curves should be lifted from 200 to 250 per cent. in cost. Moreover, there was some obvious error in the calculation of them, as the higher the pressure the more the cost rose in proportion with increase of section, so that the lines should diverge from the left of the diagram. The curves could not be straight lines, as the cost of laying was included in the price, and that was practically a constant quantity whatever the working pressure or size of the cables. If engineers were willing to work the lower-tension cables at the dielectric stress now commonly employed in super-tension cables of, say, 33,000 volts, then only mechanical reasons determined the thickness of the dielectric for all tensions up to 11,000 volts. Assuming 0.08 in. to be the minimum safe insulation thickness, then exactly the same cable could be used for any working pressure up to 11,000 volts, even allowing for possible surges of a higher percentage above the normal in the case of the lower-tension cables than in those for super tension. It was not suggested that those reduced thicknesses should be worked to in practice; money spent on providing a reasonable modicum of safety was money well spent, but it seemed that the B.E.S. standards were at present unnecessarily generous in the matter of insulation thicknesses. If the proposed "super-power" stations serving wide areas were to come into being, then in fairness a universal tariff must no longer be used, but a rate per unit, increasing with the distance between the consumer and the source of supply. The limiting load on a long feeder cable might be determined by quite a short stretch of soil that had a high heat resistance or low absorption. If cables were to be worked fully up to their maximum allowable temperature, it was necessary to join up lengths of cable of much larger section than the normal at points where the feeder entered a power or sub-station, because there the conditions were not so favourable for the dissipation of heat and the surrounding temperature was much higher.

Mr. HOLTTUM asked if it would not be possible to settle on the final distribution system and pressure for any particular case and maintain them throughout, adopting higher pressures for generation and transmission as necessary as the system expanded. Thus, the first power station might at a later stage be rearranged as a sub-station, and so on. He asked the authors whether they considered the Thury system entirely out of the running for general transmission in this country. Turning to Mr. Kapp's paper, he asked whether the statement he made with regard to the position of the power house was an argument against super power houses, and whether it was considered that undue weight would be given to considerations of water and coaling facilities and so in the end a more expensive system would be put into operation. (Mr. KAPP: Yes.) Mr. Carrothers's method of finding the most economical position of a power station with weights and strings was a very good one; the problem could not be solved theoretically, and the solution given by Mr. Morton earlier in the discussion would not give the result aimed at. Mr. Kapp's method of determining the temperature to which a cable rose could very easily be applied in practice, but seemed to have some practical objections, as one or two speakers had already hinted. There was, first, the cumulative error; each element of the heating curve was commenced from where the last one left off, and successive errors in the same direction would mount up. Then the initial temperature of the cable would appear to require special determination for the starting point of each curve. There was also the variation of the quality of the ground which Mr. Nisbett had mentioned, and, finally, the ignorance of the heating time constant. It should be borne in mind that the way in which a cable heated up depended not only on the load at the moment and on the time constant, but also on the earlier part of the heating curve. For example, suppose the cable received a 10 deg. rise, the rate at which the immediate subsequent heating took place would depend on whether the initial 10 deg. occurred under heavy load or light load, for in the former case the ground round about it would have had time to become only slightly warm, while in the latter case the ground would be warmed considerably, and subsequent heating would consequently be more rapid. As in the majority of cases the load continuously increased step by step up to the peak, there would be an accumulation of error. He supposed that the author's method would only be applicable in cases where the time constant was fairly long.

Mr. T. D. CLOTHIER said that, with regard to Mr. Kapp's quotation of distribution cost of 0.22d. per kelvin over a distance of less than 10 miles; that cost increased with increasing distance against the cost of transmitting an equivalent weight of coal by rail which, at 2.24 lb. per kelvin, was only 0.029d. per 10 miles, or 0.058d. per 10 miles at 4.48 lb. per kelvin, and that decreased with increasing mileage. He doubted the strict accuracy of fig. 3. The cost of the intermediate-pressure mains required to supply the hypothetical uniform area represented by a rectangle, would surely require some cost at the points A and B. Should not that figure be raised upon a rectangular base? With regard to the economical limits to the size of sub-stations at various pressures, assuming the reduction from 30,000 volts to the low-tension system could be made without cost by direct reduction from the 30,000-volt cables, the lower rectangle would become a triangle, the intermediate system would disappear, and the area representing cost would be reduced to exactly one-third of the expenditure shown in fig. 3. Then again, by placing three sub-stations instead of one, the area could be reduced by more than 30 per cent., so that the economical size of a sub-station was a matter of first-rate importance. Mr. Kapp's suggestion to use smaller cross sections of copper on a ring main on the feeders furthest from the power house would hardly be generally commendable, for if the ring main was to be used as a duplicate means of supply to all users on the ring, it must be contemplated that the section between the power house and the first user either way might be disconnected, in which event all users between the furthest point and the first user would be supplied through the section which it was suggested should be reduced. The temperature charts carefully avoided giving any actual temperatures; a device which could be made for attachment to underground cables at selected points for the purpose of enabling the temperature of the lead sheath or armour to be kept under observation might be of considerable practical use. However crude the result, it would be better than no information at all. Mr. Woodhouse's diagram of cost for extra-high-tension work did not include any provision for telephone and pilot cables, and must be adjusted for open country work; it would require modification for urban work especially if the roadways with reinstatement had to be used. The use of 6-core cables for 30,000-volt underground uninterrupted trunk feeders, with the protective devices which could be used with them, seemed eminently suitable. The smaller conductor section appeared to give a larger carrying capacity per equivalent cable to offset the 60 per cent. or so increase in the bulk of the dielectric.

Dr. E. W. MARCHANT pointed out that Kelvin's law was originally laid down to decide which was the most economical cable to use for transmitting a given amount of energy from one place to another, and his law was based on the fact that they wanted to make a total cost of transmitting energy from one place to another a minimum, actually that was not the right basis to take in working out the most economical working current for a cable already laid. If a cable were laid in the ground and they wanted to find out what was the most economical current to send through it, they could not take as a basis that the total cost of transmitting energy should be a minimum. The right basis to take was that the ratio of the amount of revenue earned by the energy transmitted to the total cost of sending it along the cable should be a maximum. If this basis was taken, the result was not in agreement with Kelvin's law. The most economical section was that for which the cost of energy wasted was equal to the charge for interest and depreciation on the total cost of laying the cable, not to the part of the cost which was proportional to the area of the conductor, and that, he maintained, was the real and proper economic basis on which the most economical current density should be decided; that point was not fully appreciated. It was shown many years ago by Mr. Russell in a book he wrote, but he had seen little reference to it; it was an important point, because Kelvin's law had been looked upon as something beyond dispute. The formula for current-carrying capacity which Mr. Woodhouse had given for cables of varying cross section corresponded very closely with the figures that had been obtained in the experiments made on the heating of buried low-tension cables, and they had found that the current that passed through a cable which produced a given temperature rise was very nearly proportional to the square root of its area. That seemed to lead to the conclusion that it would be more economical to transmit power with a number of small cables rather than with a small number of large cables. With reference to Mr. Kapp's paper, he fully agreed with the stress that he laid on the importance of an economical network lay-out. In Mr. Kapp's fig. 6 the crossing points of the curves, the 6,600- and the 30,000-volts, and the crossing point of 11,000 and 30,000 volts, corresponded fairly closely to the old rule that the most economical pressure for a given distance was about 1,000 volts a mile; it was an interesting coincidence. Regarding Mr. Kapp's remark that "very little was known about the time constants of cables," he hoped the figures and curves given in "The Heating of Buried Cables Report" would provide Mr. Kapp with some of the information he required.

Mr. W. B. WOODHOUSE, in reply, said he was in full agreement with Mr. Kapp on the question of protective gear. His feeling was that the elaborate inter-connecting network such as some people imagined was altogether too costly, and the proper thing to do was to split up that network into sections, feed those independent sections at a comparatively small number of feeding points, and cut down the cost of protective gear. Dealing with the equation on cost of cable, he could not agree to either of Mr. Nisbett's statements. As to showing the present-day costs for the lower-pressure cables in fig. 1, he thought it was perhaps better not to confuse them, but it was quite easy by proportion to work down from the top and put in the curves for 22,000 and 11,000 volts, and so forth. Kelvin and Prof. Marchant were both correct, but the point of view was different. There came a time when they must consider either one or the other, they could not consider both together. They had got, somehow or other, to cut down the cost of supplying electricity for a wide area; as they developed they had to make it correspondingly cheaper. Also there was the case of supplying farmers in the country.

The farmer was used to being upset in his ordinary operations for a day or a week at a time by the weather, or because the threshing machine had not turned up. He did not think the farmer minded very much if his supply was cut off for a day, he was more or less used to it. The problem of supplying a farmer was "were they to duplicate their system, or give him a supply and let him take the risk of its being cut off occasionally?" From what he knew of farmers, they were prepared to take the risk, he thought. Mr. Clothier referred to the increment cost. They had got to pay for protection somewhere or other; if they put the copper up in the air they had to provide the poles to support it and the insulators and protection, and all sorts of other things. He agreed that they must not go forward too rapidly; it would be a disastrous thing if some of the big schemes tumbled to pieces because they went ahead too fast.

Mr. R. O. Kapp, also replying, explained that the advantages of feeder-protective gear would be less strongly emphasised if one did not call it "protective" gear, which was really a misnomer, as it did not come into operation until the cable had been damaged. There appeared to be some misapprehension as to what Kelvin's law really says. According to that law the capital charges of the cost of everything that varied with the cross-section should be equal to the cost of losses for the most economical current density. In most distribution schemes the proposition was not that of laying a single cable of which the cross section had to be determined, but that of deciding how many cables of a cross section already settled had to be laid; therefore, the total cost of cables as well as a large proportion of the cost of laying them, depended on the cross section, from which it followed that, rightly applied, Kelvin's law gave far too high a current density for the safe working of 6,000-volt cables. Having regard to the greater cost per unit of the capital charges on the distribution system in the case of very large stations, it would be found that for the average conditions in this country, the cheapest electricity at the consumers' terminals was obtainable from power stations having an installed capacity in the neighbourhood of 100,000 kW. In reply to Mr. Clothier, the reason why the cross section of copper on a ring main should be reduced at parts furthest from the generating station was that at those parts the main need never carry more power than the demand between it and the generating station on one side or the other, whereas the cables leaving the generating station must allow for the whole of the power to be fed through them either clockwise or counter clockwise, so both branches of the ring must be able to pass the whole of the load on the ring. Mr. Clothier's suggestion of using pyrometers on feeders seemed to be well worth following up.

WESTERN AUSTRALIAN GOVERNMENT TRAMWAYS AND ELECTRICITY SUPPLY.

Annual Report.

The statutory annual report of the Commissioner of Railways for the year ended June 30th, 1920, covers also the operations of the tramway and electricity supply undertakings, and the statements of costs are given on identical lines as similar ones in this country; they are, therefore, comparable. The case under consideration is one in which a modest "super-power" station was established by the State to supply power to the Government tramways, and to supersede the Perth City power station (which condition has, however, not yet been fulfilled) as well as to supply electricity in general in the neighbourhood of the capital of Western Australia.

Tramway Undertaking.

The report points out that the tramways were formerly controlled by the (*a*) chief engineer of existing lines (permanent way); (*b*) electrical superintendent (rolling stock, overhead line equipment, repair shops, East Perth power house, and electricity supply); and (*c*) chief traffic manager. Soon after Mr. H. Pope took control as Commissioner of Railways the department was reorganised, the tramway and electricity supply undertakings being placed under the management of Mr. W. H. Taylor (formerly electrical superintendent), and the results have fully justified the rearrangement.

The financial result of the year's working was, after paying interest on capital invested (£28,223), a profit of £10,106, representing a return of 1.63 per cent. on the capital invested. This profit compares with a loss of £4,046 in the preceding year. The earnings for the year (£187,981) show an increase of £53,922. A total of 19,175,143 passengers was carried, representing an increase of 1,708,236. The operations for the year under review show a marked advance on the preceding year, which was seriously affected by the industrial trouble and the influenza epidemic. It is estimated that revenue to the extent of £21,600 was lost through these causes. Allowing for this, an amount of £32,322 is due to increased traffic compared with the year 1918-19.

The working expenses (£149,652) include an amount of £10,000 transferred to "belated repairs suspense account," and the payment of £5,473 to local authorities on account of the 3 per cent. contribution. The expenditure shows an increase of £38,554, although the cost per car mile is 0.16d. less than in the preceding year, which does not, however, afford a proper basis for comparison, for the reason that the system was closed down from December 21st, 1918, to February 7th, 1919. On this account, the expenditure was considerably less than it would have been under normal conditions.

During the year 2,530,730 car miles were run, an increase of 672,358 miles, equivalent to 36.18 per cent. The earnings per car mile were 17.83d., or an increase of 0.52d., and the number of passengers per car mile increased by 0.31.

On June 30th last the system operated consisted of 27 miles 20½ chains of route mileage. No additions to the system were made during the year.

The duplication of certain sections of the track will be undertaken as soon as the electric welding plant (which has been on order for some time) comes to hand. In the past the rail joints have been thermit welded, but it has been decided to adopt the electric welding process, in accordance with the latest practice. It is expected that substantial economy will be effected by this means.

The condition of certain sections of the track will necessitate relaying at the earliest opportunity. Twenty additional bogie cars, each having 92 seats, are to be built in the Midland Junction workshops, and a complete scheme of tramway extensions, providing for the requirements of the city and suburban area, covering both immediate and future needs, with estimates of the costs of the individual works, has been prepared.

On June 1st last the fare system applying on the tramways was revised, and the cash sectional fare system—based on one penny sections—was introduced. All concession tickets, including workers' return tickets and transfers, were abolished. Workers now pay one penny on the morning journey and full fare on return, in lieu of full fare in the morning with a ticket entitling them to free return at any time of the day. One of the features of the net result has been the reduction from twenty to five only, as a maximum, of the number of different chits and tickets handled by conductors and others of the staff. In addition to the saving in cost of printing, this has simplified the work of the conductors, and reduced the clerical work considerably. The new system is working satisfactorily, and gives every indication of leading to increased business, as short-distance passengers who formerly walked in preference to paying the 3d. fare, are now using the cars.

Electricity Supply.

The past year has been one of marked progress for this undertaking, and in view of the fact that the output from the plant only commenced in December, 1916, the result which has been attained is very gratifying. The rapidly increasing sales of energy, and the nature of the prospective new business, indicate that the concern is fulfilling the purpose for which it was established, *i.e.*, an assured and ample supply of power, at a cheap rate, to encourage the establishment of secondary industries within the State.

The sale of energy during the year totalled 18,446,896 units, an increase of 5,024,818 units over the preceding year; the average selling price was 0.869d. per unit. The earnings amounted to £66,852, an increase of £19,945.

The operating expenses were £43,163, an increase of £14,862. The price of the "small" native coal used was increased from 6s. 11d. to 9s. 6d. at the pit's mouth, and applied throughout the year; this item represents 75 per cent. of the operating costs, and of the increased operating expenses (£14,862), an amount of £11,029 is in the fuel account.

The financial result of the year's operations was, after paying interest on capital invested (£19,643), a profit of £4,046; £5,896 was, however, transferred to "antiquation suspense account," and after allowing for this the result was a loss of £1,850 on the year's operations. Compared with the preceding year, wherein the loss was £5,722, this result must be regarded as satisfactory.

The complete installation of the switchgear under the original contract has been practically completed; the switchgear at the power house for the Fremantle and Midland Junction transmission lines is also complete. There is now an entirely duplicate supply to each of these districts. The boiler house efficiency has received much consideration during the year, in view of the increasing cost of fuel, to enable the poorer grade coal to be burnt economically. For the purpose of enabling "duff" coal to be used, a Sandford-Riley multiple retort stoker is to be fitted to one of the existing boilers. It is considered that substantial economies will be possible by the adoption of these stokers.

The distribution system has operated satisfactorily throughout the year. Considerable improvements have been made to the outdoor switching arrangements, to ensure continuity of supply, and the change over to the Government system by the Perth City Council is expected to be effected shortly. A 20,000-V transmission line has been taken out to Keswick, to provide a supply at that point, as well as to Gosnells and the surrounding districts. In addition to ordinary industrial establishments, there are large possibilities in the utilisation of electric power for the treatment of minerals, such as iron, lead, and copper. This aspect has been receiving consideration, and the question has been gone into somewhat fully. It is hoped that something tangible may be done in this respect.

With regard to plant extensions, the following tenders have been accepted: Messrs. C. A. Parsons & Co., one 7,500-kW turbo alternator and condensing plant, &c. Messrs. Babcock

and Wilcox, Ltd., two boilers, economiser, fan, chimney, &c. The turbine embodies the new form of blading, which ensures low steam consumption. The new boilers will be fitted with Sandford-Riley stokers. It is hoped that circumstances will permit of this plant being promptly delivered, as it is desired to have it installed in time for next winter's load.

Turning to the technical statistics, the plant capacity is 12,000 kW; the maximum load 6,600 kW, an increase of 700 kW; and load factor 36.65 per cent., an increase of 6.09 per cent. The units sold numbered: tramways 5,535,977, an increase of 1,708,236; Perth City Council 6,119,590, an increase of 1,636,391; a.c. bulk supplies 6,791,329, an increase of 1,680,191. The coal burnt per kWh was 3.3 lb., a decrease of 0.1 lb.; its energy value (B.th.u.) was 2.64 kWh and the amount used was 31,978 tons, an increase of 8,602 tons.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR DECEMBER, 1920.

In the aggregate there is little difference between the returns for December and those for the previous month. Exports fell £9,958, or about 6 of 1 per cent. Decreases occurred in the figures for the export of unenumerated goods, insulated wire, glow lamps, batteries, meters, "other motors and generators," electrical machinery (unenumerated), and switchboards. The total figures were kept level by large increases in the export of telegraph and telephone cable and material. This class showed an increase of £281,644—or approximately 88 per cent. on November's figures.

Imports rose £33,135, the principal items of increase being the "unenumerated" goods and apparatus and telegraph and telephone instruments.

Re-exports, however, were £10,476 higher than in the previous month, an increase of 56 per cent.

VALUES OF ELECTRICAL EXPORTS AND IMPORTS FOR DECEMBER, 1920.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£244,543	£132,624	£9,378
Insulated wire	313,350	14,351	—
Glow lamps	26,461	12,236	2,958
Arc lamps and parts	4,742	9,107	15
Batteries	75,932	13,162	—
Meters	29,888	15,468	2,649
Carbons	29,288	18,304	100
Electrical machinery:—			
Railway and tramway motors ...	15,127	—	—
Other motors and generators ...	191,964	—	—
Electrical machinery (unenumerated)	121,609	146,822	5,281
Switchboards (not telegraph or telephone)	13,860	8,668	—
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	125,079	6,319	1,215
Submarine telegraph and telephone cable	326,295	—	—
Telegraph and telephone instruments and apparatus	150,844	52,037	7,426
Totals... ...	£1,668,982	£429,098	£29,022

Below we give comparative figures of the values of electrical exports for 1919 and 1920, taken from the latest B.o.T. returns.

ELECTRICAL EXPORTS FOR 1919 AND 1920.

	1919.	1920.	*Inc. or dec*
Electrical goods ...	£1,331,844	£2,117,453	+ £785,609
Insulated wire ...	1,906,731	3,797,310	+ 1,890,579
Glow lamps... ...	149,907	319,382	+ 169,475
Arc lamps and parts	18,514	36,057	+ 17,543
Batteries	435,332	627,584	+ 192,252
Meters...	239,848	396,421	+ 156,573
Electrical machinery	1,952,528	2,794,099	+ 841,571
Carbons	12,801	149,757	+ 136,956
Teleg. & telep. material and apparatus.	1,563,644	4,043,390	+ 2,479,746
Totals	£7,611,149	£14,281,453	+£6,670,304

British Engineering Standards for Argentina.—A special correspondent of the *Times Trade Supplement* of Jan. 8th drew attention to the desirability of standardisation, to reduce the cost of manufactured goods. For this purpose a Committee was formed in Buenos Aires, and was affiliated to the British Chamber of Commerce in that city; the Committee has drawn up new metric standards for steel beams, angles, and channels, which, it is claimed, are superior to the local or "Continental standards," combining strength, lightness, and even metric sizes. It is pointed out that those working on the spot are constantly meeting with cases which show the urgent need for standard types when important contracts are at stake. Various other subjects are being examined by the Committee, including electrical plant of all kinds.

ELECTRICITY SUPPLY IN N.E. LONDON.

A COPY of the report on the future development of electricity supply in the eastern districts of Greater London north of the river Thames, which has been submitted by Mr. E. M. Lacey, M.I.E.E., consulting engineer, to the Electricity Committees of the county borough of West Ham and the metropolitan borough of Poplar, has just reached us. It is dated May 12th, 1920, and an abstract of a preliminary report dated March 28th, 1919, has already been published.* Mr. Bruce Dawson, F.R.I.B.A., and Mr. W. M. Selvey, M.I.E.E., assisted in the preparation of the report, and both would collaborate with Mr. Lacey so far as regards any further work which may arise in connection with the scheme he has recommended. The report is an extensive one and is divided into two parts, viz., Part 1: Administrative scheme for Greater London, and Part 2: Electricity supply in north-east London, with appendices, maps, and plans. The chief recommendations of the report are:—

Part I.—The area primarily considered for the administrative scheme proposed in this report is that known as Greater London and certain districts adjacent thereto. In order to achieve the object of the Electricity (Supply) Bill, 1919, main generating stations should be erected on selected sites adjacent to the river Thames, and should be operated in conjunction with the more efficient of the existing generating stations. The new main generating stations should be designed for an a.c., three-phase supply and a frequency of 50 cycles per second. An electricity authority for Greater London should be constituted to exercise supreme control of the incidence and extent of all capital expenditure and over all such works, matters and things as may be necessary from time to time to secure the effective co-ordination of the electricity undertakings of Greater London and the most economical production and supply of electricity. In order to avoid the evils of over-centralisation and to secure the co-operation and valuable local knowledge of the existing organisations and their executive officers, the Electricity Authority should delegate to Divisional Boards all executive functions; for the technical guidance of each Divisional Board an Advisory Committee consisting of engineers of the existing undertakings should be appointed. The Electricity Authority should confine itself to broad principles and financial policy, and should delegate to the Divisional Boards all technical functions, which would be exercised under the technical guidance of the Advisory Committees. The engineers of the existing undertakings should suffer no loss of status by reason of the proposed amalgamation, and it must be recognised that the success of any joint scheme will always depend upon the zeal and enterprise of the principal technical and executive officers, and the organisation should be sufficiently flexible to obtain the assistance and advice of consultants. In the event of differences arising there should be the following rights of appeal: (*a*) By Divisional Boards to the Electricity Commissioners as to the decisions or directions of the Electricity Authority. (*b*) By authorised distributors to the Electricity Authority, and finally to the Electricity Commissioners, as to the decisions of the Divisional Boards. (*c*) By large consumers to the Electricity Authority, and finally to the Electricity Commissioners, as to the terms and conditions of a Divisional Board for electricity supply. (*d*) By ordinary consumers to the Divisional Board concerned as to the terms and conditions of the authorised distributor.

A comprehensive administrative scheme for Greater London should provide for the friendly co-operation of company-owned electricity undertakings, and one way to secure this would be for the Electricity Authority or the Divisional Boards to take on lease the existing generating stations of the companies, for the remaining period of their tenures. Municipal credit should be utilised to the fullest extent possible, by the guarantee of stock or otherwise, in order to raise the capital required on the most advantageous terms. No direct profits should be made by Divisional Boards on supplies to authorised distributors, but a limited profit might be made on direct supplies to railways or large consumers.

Part II.—The aim of the scheme formulated above is to provide an Electricity Authority as being most conducive to convenience of administration and to the efficiency and economy of the supply of electricity in the whole of Greater London and the contiguous areas. The application of this scheme to North-East London, in which the Corporations of West Ham and Poplar are more particularly concerned, has now to be considered.

The proposed field of supply extends from Grays Thurrock on the east, to Shoreditch on the west, and from the river Thames on the south, to the boundary of Greater London on the north. It is by far the most important industrial area of Greater London, and with the unimportant exceptions of a few outlying districts, viz., Chingford, Orsett, Romford, Tilbury, and Waltham Holy Cross, the powers to supply electricity are in the hands of local authorities, comprising the metropolitan boroughs of Bethnal Green, Hackney, Poplar, Shoreditch, Stepney, Stoke Newington, and Woolwich; the county boroughs of East Ham and West Ham; and the urban districts of Barking, Grays Thurrock, Ilford, Leyton, and Walthamstow. The inclusion of Woolwich, which lies both north and south of the river Thames, presents no engineering

* ELEC. REV., June 13th, 1919, p. 711.

difficulties, there being a tunnel under the river which can be utilised for inter-connection or transmission mains. With regard to certain contiguous areas, such as the metropolitan boroughs of Islington, Hampstead, St. Marylebone, and St. Pancras, the prospective business in North-East London alone is more than sufficient to justify the initiation of a scheme of considerable magnitude, and although these contiguous areas might well be included, there is for the time being no urgent necessity to do so.

The population of the district which is considered in this scheme is 1,873,699. The present consumption of electricity exceeds 165,000,000 units per annum, being less than 100 units per head of the population, which is considerably above the average for the whole of London. That this consumption will be increased largely in the future cannot be disputed, more particularly having regard to the future requirements for railway traction. It does not seem unreasonable to assume that possibly within six or seven years, the units consumed will be at least 200 per head of the population, or about 374,000,000 per annum.

The most effective policy of development would be to complete the inter-connection of existing generating stations, to close down inefficient generating stations, and to concentrate in one main generating station all the plant necessary to meet progressive needs, such station to be operated in conjunction with the more efficient of the existing generating stations, the latter remaining in being for so long only as the actual results show that they are for the general good of the co-ordinated system.

A frequency of 50 should be the standard for the whole of London; there is now no reason why rotary transformers of this frequency should not operate perfectly satisfactorily for railway supplies. In the proposed area the total plant capacity is about 98,000 kW, there being some 42,000 kW of small and inefficient sets and 56,000 kW of reasonably efficient ones, comprising steam-turbine-driven alternators of from 1,500 up to 6,000 kW each. In addition there are some 36,000 kW on order, and it may be taken that by the winter of 1921-22 there will be installed a total of at least 92,000 kW of efficient and fairly efficient plant which, having regard to the inter-connection of the Poplar, Shoreditch, Stepney, and West Ham generating stations, should be sufficient to assure the maintenance of the supply, up to a maximum demand of about 66,000 kW. Some of the stations, and more particularly Barking, East Ham, Ilford, and Leyton, are uneconomical, and the progressive needs of the areas they supply could be better met by a system of interconnected transmission mains linking them up to the West Ham, Poplar, Stepney, Hackney, and Walthamstow generating stations. Other stations, such as Poplar, are restricted by the limitations of the existing sites. Considerable extensions comprising three 10,000-kW sets for West Ham and Stepney, and 6,000 kW for Poplar have been put in hand with the approval of the Electricity Commissioners, but these will only meet the more immediate needs. Finally, none of the generating stations of the undertakers could be economically extended to accommodate the large units of plant which will be required to meet the progressive demands of North-East London.

The maximum demand on the feeders of the fourteen existing undertakings is 61,942 kW, and the load factors of the larger of the existing stations vary from 26 to 47 per cent. The total units sent out from the several stations may be taken as approximately 171,510,000. In order to arrive at the present maximum demand, if the existing stations were co-ordinated and operated as one system, it is necessary to take into account the diversity of the several demands; and if this factor be 1.2, the coincident maximum demand would be 51,600, with a resultant load factor of 36 per cent.

The estimated demand is 105,800 kW for the year ending March, 1924. This increase in the maximum demand of nearly 44,000 kW in five years is a little more than 10 per cent. per annum, and does not include the railway demand for traction purposes, which is almost certain to come, if not by the year 1924, then very shortly after, and it would be wise to provide for demands for all purposes aggregating not less than 125,000 kW by the year 1924-25 particularly having regard to the probable electrification of the railways in the district. The above total will be reduced by the diversity of demand, when the whole system is co-ordinated, and taking this factor as 1.25 for the increased demand, the operating plant required will be 100,000 kW which, on a 40 per cent. load factor, would represent an output of 350,000 units sent out per annum, or about 158 units sold per head of the population served. In order to meet the anticipated demand additional plant will be required in the immediate future for a further operating capacity of 34,000 kW.

An increase of the population of the district to 2,000,000, and a probable consumption of 200 units per head in the next decade, cannot be regarded as unduly optimistic. In order to provide for such a demand, the total units annually sent out from the combined stations would be about 460,000,000 which, with a 40 per cent. load factor, would represent a coincident maximum demand of about 130,000 kW. The existing generating stations will provide for a maximum demand of 66,000 kW and, therefore, the main station would have to be designed for a minimum operating capacity of 64,000 kW. This demand would justify the provision of an initial main station, designed for a total plant capacity of not less than 100,000 kW, comprising five sets of 20,000 kW each. At the same time, regard should be given to the progressive needs for electricity during the next generation, and the station should be designed on a selected site where an ultimate plant capacity of not less than 400,000 kW could be installed.

The site which appears best to meet the essential requirements is situated to the east of and adjacent to Dagenham Dock. In extent it is some 170 acres, of which 52 acres are made up land and suitable for building. Within about two hundred yards are sidings from the London, Tilbury, and Southend Railway, and a well-equipped coaling pier, which will accommodate vessels up to 5,000 tons at all states of the tides, and the unmade ground would be used for the deposit of ashes.

The main plant would consist of 20 water-tube boilers and five turbine-driven alternators. The boilers would be independent units, consisting of boiler, superheater, economiser, and mechanical stoker, with forced and induced draught, and would be designed for a working pressure of 320 lb. per sq. in., with a total steam temperature of 700 deg. F. The turbine-driven alternators would be designed for a continuous output of 20,000 kW at 0.8 power factor, the current being three-phase and 50 cycles, generated at a pressure of 6,600 volts. The latter would be increased to 33,000 V by means of step-up transformers, and all switchgear would be designed with a view to an ultimate station capacity of 400,000 kW. An auxiliary turbine-driven alternator would be provided for operating the circulating water pumps, the forced and induced draught apparatus, and other auxiliaries in cases of emergency; but under ordinary working conditions, all such auxiliaries would be operated by the main plant.

The total cost of the generating station would be £2,500,000, but the progressive needs will probably be met by the initial provision of 60,000 kW of plant.

The transmission mains would be designed for a working pressure of 33,000 V, three-phase, 50 cycles. They would be 6-core, paper-insulated, lead-covered, and steel armoured cables laid solid in a suitable compound. Subject to wayleaves being obtained, some of the mains would be carried overhead on steel masts to the northern outfall sewer of the London County Council, which would be utilised to the fullest possible extent in order to reduce the use of public roads to a minimum. From the sub-stations a subsidiary system of transmission mains would supply the various authorised undertakers. The total cost of the transmission system for a maximum demand of 72,000 kW will be £1,110,000. Considerable progress has recently been made in the manufacture of cables up to 66,000 volts and, provided satisfactory guarantees can be obtained from the makers, the above estimate could be reduced by well over £200,000. In the beginning it would in all probability be sufficient to arrange for the transmission of (*a*) about 20,000 kW to a point suitably situated for a supply to West Ham, Poplar, Stepney, Shoreditch, and Woolwich, and (*b*) about 15,000 kW to a point suitably situated for a supply to Hackney, Walthamstow, Leyton, and Ilford. A subsidiary system of transmission mains would also be required for inter-connecting the several existing generating stations. The cost of the initial scheme would be approximately £600,000. The cost of the energy delivered from the initial main station would be 0.768d. per unit.

It is probable that some considerable time may elapse before a voluntary scheme for the establishment of a Greater London Electricity Authority, in accordance with the provisions of the Electricity (Supply) Act, 1919, is finally agreed to. However, these questions need not delay the initiation of a scheme for North-East London, provided the Electricity Commissioners approve the general principles of the administrative scheme submitted in the preceding part of this report, *i.e.*, that there should ultimately be one electricity authority for the whole of Greater London. Subject to the above, the Corporations of West Ham and Poplar, in association with the other twelve local authorities owning electricity undertakings in North-East London, could proceed forthwith with a joint scheme for the reorganisation of their existing generating stations and the provision of a main generating station to meet their progressive needs. There would be no difficulties so far as regards the participation or co-operation of undertakings owned by companies, because there is none of any importance in the whole of the proposed area, and so far as regards finance the fourteen local authorities have vested in them powers to raise money for electricity purposes on the security of their rates, being in this respect in a better position than an electricity authority established under the provisions of the Electricity (Supply) Act, 1919. The approval of the proposed procedure by the Electricity Commissioners would, of course, be required, and this could be applied for under Clause 19 of the Electricity (Supply) Act, 1919.

Until some administrative scheme is approved by the Electricity Commissioners it would be necessary for the existing authorised undertakers to enter into arrangements for such an organisation as would best control the proposed joint electricity undertaking and which could, when the time arrived, be merged in a general administrative scheme for Greater London. Following the principles of the administrative scheme formulated in the first part of this report, the formation of a Joint Board is recommended, which would deal with all administrative and executive work, and the appointment of an advisory committee of engineers, which would be respon-

sible for the joint operation of the whole of the existing generating stations in the manner best calculated to obtain the most economical production of electricity.

The basis of the representation on the proposed board should so far as possible be in accordance with the provisions of the Electricity (Supply) Act, 1919, as follows: For authorised distributors, one representative in any area for every 75,000 of population. For authorised undertakers owning generating stations, one representative per 10 million units output in excess of two millions pc. annum. For the consumers, two representatives to be appointed by an association of consumers to be formed for the purpose, and for labour, two representatives to be appointed by agreement between the recognised trade unions in the area controlled by the Joint Board, which would give a total of 60 representatives.

A JOINT ELECTRICITY AUTHORITY.

The West Riding (Aire and Calder) Scheme.

What follows is an abstract of the draft scheme (which is signed by Sir Robert Fox, town clerk to the City of Leeds, Mr. C. N. Hefford being engineer and manager of the electricity department) which has been submitted to the Electricity Commissioners by the Leeds Corporation for the constitution of a Joint Electricity Authority for the provisionally delimited West Riding (Aire and Calder) Electricity District.* Following our usual practice only those points are dealt with hereunder whereon the scheme differs from those of which outlines have already been published.†

The scheme is divided into three parts, viz., administration, technical, and financial. It provides that the Electricity Authority shall consist of 19 members and shall be representative of: (*a*) All authorised undertakers and distributors within the district, and (*b*) all local authorities having the right to purchase the whole or any part of the undertaking of any authorised undertakers within the district, and such local authorities and companies shall be entitled to one vote for every 60,000 units supplied during the last preceding financial year, provided always that each local authority with purchase rights shall be entitled to one vote for every 60,000 units supplied within its area by the authorised distributors.

The Electricity Authority may at any time after the expiration of 42 years from the date of coming into operation of this scheme, give notice in writing to the Yorkshire Electric Power Co. requiring it to sell its undertaking to the Electricity Authority upon the terms set out in Section 2 of the Electric Lighting Act, 1888.

The Electricity Authority, when formed, will proceed in stages to interlink generating stations in the area to a control station which it is suggested should be installed in the existing generating station at Morley (now in process of being shut down). The stations to be interlinked will be those at Leeds, Bradford, Batley, Thornhill, and Wakefield, with extensions from Bradford to Shipley and Keighley, from Wakefield to Barnsley, and from Batley to Dewsbury. At a later date the linking up system to Morley will be extended to embrace Halifax and Huddersfield, and still later to connect to the proposed third "capital" station at Knottingley.

The system of supply to be adopted will be three-phase a.c., 50 periods. The main transmission pressure is to be 33,000 V, stepped up from a generating pressure of 6,600 V. It is probable that the transmission pressure between Morley and Knottingley will be 66,000 V. Intermediate pressures of 6,600 and 11,000 V will be utilised in certain cases to take advantage of existing cable networks. The proposed transmission mains to be laid during the first few years will consist of 17 3-core cables each 0.2 sq. in. in section, and the extensions will consist of eight of the same type. Ultimately, it is estimated that 55 3-core 0.2 sq. in. cables will be laid to deal with the load of the area in 1935, and that the extensions of this network will consist of eleven cables of the same type.

It is proposed that a new "capital" generating station shall be installed in Leeds on the banks of the Aire near South Accommodation Road, generating electricity at a pressure of 6,600 V, 3-phase, 50 periods, which is to be stepped up by suitable transformers to 33,000 volts for main transmission; that a second "capital" station be constructed at Wakefield to be sufficiently in commission by 1930; and that a third "capital" station be constructed at Knottingley, with adequate boiler plant, to be sufficiently in commission by 1933. The ultimate capacities of these three stations to be: Leeds, six 25,000-kW generators, with adequate boiler plant. Wakefield, six 25,000-kW generators, with adequate boiler plant. Knottingley, eight 35,000-kW sets. Suitable capacity in transformers will have to be provided at the various generating stations linked up, and it is proposed to install units varying from 2,500 to 10,000 kVA, in accordance with the requirements of individual cases. The following extensions of plant in connection with main generating stations in the area are in course of construction: Leeds, one 12,000-kW set. Bradford, one 12,000-kW set. Halifax, one 10,000-kW set. Thornhill (Yorkshire Electric Power Co.), three 10,000-kW sets. There will still be space available for installing one more 12,000-kW set at Leeds.

Until the first "capital" station is in commission, all existing stations will be required, but when the "capital" station at Leeds is sufficiently advanced to give an output continuously of 50,000 kW, the stations at Batley, Wakefield, and Barnsley can be completely shut down and in addition, during the summer, the stations at Keighley, Shipley, and Dewsbury will cease to operate. Also in the summer time the amount of power generated by Bradford, Halifax, Huddersfield, Leeds, and Thornhill will be considerably reduced. The total of the maximum loads of the eleven generating authorities concerned is at the present time 105,000 kW, and it is anticipated that in five years' time this will increase to 180,000 kW. There is installed at present in the area approximately 188,000 kW of engine-room plant and 150,000 kW of boiler plant capable, when reasonable spare plant is deducted, of dealing with a load of 120,000 kW. In five years' time it is estimated that the ultimate capacity of existing power stations in the area with regard to boiler plant will be 205,000 kW, which, allowing for reasonable spare capacity, will deal with 165,000 kW, indicating a definite shortage by that date of at least 15,000 kW, assuming all the plant in the area to be in a fit condition for use.

It is proposed that the Ministry of Transport should proceed forthwith with the erection and equipment of the first section of the "capital" station at Leeds. The scheme will not be capable of providing for railway requirements until the second "capital" station is in commission, but tramway requirements can be dealt with when the first "capital" station is in commission.

The Minister of Transport shall, in pursuance of the Act, erect the necessary capital stations and provide and lay all transmission mains for the interlinking of generating stations, including the proposed capital stations and the Yorkshire Electric Power Co., and also such additional transmission mains as may be necessary for supplying electricity to all authorised distributors, and shall provide such working capital as may be necessary in connection with the operation of the said capital stations and the administration of the Electricity Authority, and all such capital stations and mains shall vest in the Electricity Authority within the period prescribed by the Act, and the amount so expended by the Minister of Transport, together with interest at the rate of £6 per cent. per annum, shall be repaid by the Electricity Authority out of the net revenue derived from the working of such capital stations after payment of all outgoings and expenses, including the costs and expenses of the administration of the Electricity Authority.

The reserve fund may be applied in providing for:—

(*a*) Any deficiency in the income of the Electricity Authority.

(*b*) Any extraordinary claim or demand which may be made at any time against the Electricity Authority.

(*c*) Depreciation and renewal of plant.

(*d*) Reducing the capital moneys borrowed by the Electricity Authority.

* Elec. Rev., June 25th, 1920, p. 815.

† Elec. Rev., December 24th, 1920, p. 809; January 7th, pp. 4 and 10, and 14th, p. 61.

Electrical Supplies in South Africa.—The *S.A. Mining and Engineering Journal*, in its issue for December 11th, 1920, says: **There is no improvement to report, business being very quiet in town and along the Reef. Prices generally remain very firm, but lamps, which are again becoming scarce, have increased in price about 10 per cent., and are now selling retail at from 27s. to 36s. This increase affects only existing stocks, as in view of a 12½ per cent. advance in home prices, owing to dearer raw materials, future consignments will be higher. Gas-filled lamps are also very scarce, but the price has not yet been raised here, although the home quotation is considerably higher. All lines of materials generally are arriving freely. The fact is being emphasised that Germany is coming into our market with wares at prices considerably below English quotations, varying from 40 per cent. to 75 per cent. Of course, Holland draws a great deal on Germany, and we are getting a lot of goods from the former country which are really of German manufacture. As showing the impossibility of English goods competing with those of Holland and Germany at the present time, one of the largest dealers in town has just received a large consignment of German stuff at a price about 75 per cent. below English cost. Can it cause wonder that when the difference in price between English and German goods is so tremendous, altruistic and patriotic feelings necessarily go by the board?**

The Miners' Lamps Committee.—Mr. W. C. Bridgeman, **the Secretary for Mines, has reappointed the Committee which was appointed by the Home Secretary last May to inquire and report on possible improvements in miners' lamps as regards safety and illumination and alterations which may be desirable in the present methods of testing and approving such lamps for the purposes of Sec 33 of the Coal Mines Act, 1911. The terms of reference to the Committee have been extended as follows:—Whether the present arrangements for maintaining such lamps in a safe and efficient condition at the mines are adequate, and, if not, what steps should be taken to improve them; and what steps should be taken to safeguard the general use by the workmen in a mine of safety lamps which give no indication of inflammable or noxious gases.—*The Times*.**

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

2. "Electrical power transmission systems." A. M. Taylor. January 3rd.
26. "Control and inter-communication system for railway trains in fog, &c." M. R. Howard and A. W. Pizzey. January 3rd.
28. "Covers for electric switches." J. W. Sanderson. January 3rd.
92. "Manufacture of electro-plated articles." W. E. Bourfield. January 3rd.
95. "Telephone call recorder." S. J. Alavoine. January 3rd.
126. "Telephonographs." Telegraphon Ges. January 3rd.
160. "Preservation of electric motor from action of surrounding medium and ensuring lubrication and cooling of motor." R. Longue. January 3rd. (France, March 4th, 1920.)
163. "Electrical conductors, resistance bands, &c., for reproduction of sound waves." R. Mylo. January 3rd. (Germany, January 2nd, 1920.)
164. "Apparatus for reproduction of sound vibrations." R. Mylo. January 3rd. (Germany, January 2nd, 1920.)
185. "Electrically-controlled signals for railways." J. Bethenod. January 4th. (France, November 22nd, 1918.)
215. "Electric switches." S. F. Woodell. January 4th.
235. "Cab signal and train control system." M. H. Loughbridge. January 4th.
240. "Electro galvanising machine." Meaker Galvanising Co. and F. H. Rogers (Meaker Galvanising Co.). January 4th.
242. "Electric controller." G. M. Shearer and F. H. Taylor. January 4th.
263. "Transformers." J. B. Hansell and Metropolitan-Vickers Electrical Co., Ltd. January 4th.
265. "Vapour-electric current rectifying apparatus." A. S. Cachemaille (Westinghouse Lamp Co.) and Westinghouse Lamp Co. January 4th.
297. "Wireless signalling aerials." T. L. Eckersley. January 4th.
306. "Electric railways." Compagnie du Chemin de Fer de Paris a Orleans. January 4th. (France, August 3rd, 1917.)
324. "Manufacture of armature and stator coils or windings for electric motors." A. H. Hibbs. January 5th.
335. "Electric lanterns." J. Eaton and Elandem Co., Ltd. January 5th.
340. "Telephone systems." D. Macdonald. January 5th.
346. "Switchgear for controlling electric motors." P. S. Brook and J. A. Hirst. January 5th.
356. "Electric condensor." W. Dubilier. January 5th. (United States, January 18th, 1916.)
370. "Enclosed electric fuses." A. L. Eustice. January 5th. (United States, June 21st, 1918.)
371. "Fuses." A. L. Eustice. January 5th. (United States, September 3rd, 1918.)
372. "Fuse terminal attaching means." A. L. Eustice. January 5th. (United States, March 31st, 1919.)
377. "Electric signalling or alarm apparatus, &c." J. Wilson. January 5th.
400. "Electric switches." H. Edmunds. January 5th.
421. "Transmitting arrangement for submarine sound signals." Signal Ges. January 5th. (Germany, October 9th, 1914.)
424. "X-ray photography." N. E. Luboshey. January 5th.
431. "Electric relay devices." J. B. P. Brydon and S. Brydon. January 5th.
436. "Contact springs for switching apparatus." Siemens & Halske Akt.-Ges. January 5th. (Germany, May 29th, 1914.)
437. "Electric, &c., insulating materials." Siemens-Schuckertwerke. January 5th. (Germany, October 20th, 1917.)
438. "Operation of electro-magnetic couplings." Siemens-Schuckertwerke. January 5th. (Germany, December 12th, 1919.)
461. "Electric relays." N. W. McLachlan. January 5th.
466. "Combined resistance and cut-out." Thor Electric Safety Lamp Co., Ltd. January 5th.
493. "Electric switches, ceiling roses, plug and socket couplings, &c." A. Davis, Davis, Hudson & Co., and F. R. Hudson. January 6th.
504. "Electrical fittings." H. Columbine, G. Hargreaves, and A. T. Rooks. January 6th.
578. "Systems of electric motor control." British Thomson-Houston Co., Ltd., and N. Shuttleworth. January 6th.
603. "Electric switches." R. K. Mason. January 6th. (United States, July 8th, 1919.)
613. "Electrode for introducing medicaments into the skin." W. Froese. January 6th. (Germany, May 16th, 1919.)
638. "Wireless antenna systems." Ges.-für Drahtlose Telegraphie. January 6th. (Germany, October 11th, 1919.)
639. "High and low frequency telephone systems." Ges.-für Drahtlose Telegraphie. January 6th. (Germany, January 7th, 1920.)
652. "Means for regulating terminal voltage of electrical valve tubes." F. Schroter. January 6th. (Germany, September 1st, 1919.)
657. "Fusible electric cut-outs and distribution fuse boards." H. C. Hodges. January 6th.
668. "Polyphase transformers." Bergmann Elektricitats-Werke Akt.-Ges. January 6th. (Germany, October 22nd, 1917.)
669. "Conductors for electric machines." Bergmann Elektrictats-Werke Akt.-Ges. January 6th. (Germany, November 26th, 1917.)
670. "Conductors for electric machines." Bergmann Elektricitats-Werke Akt.-Ges. January 6th. (Germany, February 20th, 1914.)
691. "Receivers for electro-magnetic wave systems." H. J. J. M. de Regnauld de Bellescize. January 7th. (France, October 10th, 1919.)
693. "Series field windings for continuous-current dynamo machines." H. E. Dance. January 7th.
723. "Electric ignition apparatus for internal combustion engines." H. W. F. Ireland and H. Lucas. January 7th.
730. "Electric exploration of interior of the earth." H. Lowy. January 7th. (Germany, March 27th, 1919.)
731. "Electro-magnetic clocks." C. J. V. Fery. January 7th. (France, January 8th, 1920.)
742. "Means for recording telephone messages." E. H. Kinnard. January 7th.
744. "Attachment for telephone mouthpieces." J. S. Burfield. January 7th.
760. "Step-down transformers." J. C. Savidge and E. L. Terrey. January 7th.
765. "Control of electric circuits." H. Edmunds. January 7th.
771. "Electric fuses." Metropolitan-Vickers Electrical Co., Ltd. January 7th. (United States, January 12th, 1920.)
787. "Electric pocket lamps." A. Luzy. January 7th. (France, August 4th, 1919.)
827. "Wireless and light signalling devices." A. U. Sarnmark. January 7th. (Sweden, December 1st, 1919.)
836. "Wireless phonographs, &c." E. C. Hanson. January 7th. (United States, June 3rd, 1918.)
842. "Electric head lights." Soc. Anon des Usines J. Gallay. January 7th. (Switzerland, October 9th, 1919.)
853. "Incandescent electric lamps." N. Wise. January 7th. (United States, February 7th, 1919.)
859. "Sparking plugs." F. L. Madler. January 7th. (Germany, June 3rd, 1919.)
880. "Electrical transmission arrangements for motor vehicles, &c." J. Sankey & Sons, Ltd., and W. A. Stevens. January 7th.
890. "Cable transmitters." F. L. Rogers. January 7th. (United States, May 5th, 1919.)
892. "Electric pocket magneto lamps, &c." F. E. V. Le Tellier. January 7th. (France, 10th, 1919.)
917. "Appliances for testing sparking plugs." H. L. Curzons. January 8th.
918. "Electrically-driven travelling, &c., cranes." G. F. D. Campbell, W. Heap, and J. Meredith. January 8th.
930. "Revolving nosepieces for gas and electric fittings." A. Rayhould. January 8th.
932. "Arrangement of brushes for disk-shaped commutators." Krupp Akt.-Ges. January 7th. (Germany, January 17th, 1917.)
939. "Electric gas lamps with glow discharge." Studienges fur Elektriscke Leuchtrohren. January 8th. (Germany, May 3rd, 1918.)
941. "Sparking plug." F. Carpenter, W. Dix, and W. Woodrow. January 8th.
946. "Galvanic battery." E. Wilke. January 8th. (Austria, December 10th, 1919.)
950. "Apparatus for converting and/or transforming electric currents." J. E. Calverley and W. E. Highfield. January 8th.
958. "Frames for windings of electrical resistance or heating elements." Widerstand Akt.-Ges. für Elektro-Warme-Technik. January 8th. (Germany, September 13th, 1918.)
959. "Electrical resistances." H. Behn (né Ephinius). January 8th. (Germany, January 4th, 1916.)
963. "Electrical cooking apparatus." W. D. Wright. January 8th. (United States, February 5th, 1916.)
983. "Testing arrangements for telephone installations." Siemens and Halske Akt.-Ges. January 8th. (Germany, March 26th, 1918.)
985. "Insulating material for electric purposes." Siemens-Schuckertwerke. January 8th. (Germany, December 14th, 1917.)
986. "Insulating substances." Siemens-Schuckertwerke. January 8th. (Germany, January 8th, 1918.)
987. "Submarine telegraph, &c., cables." Siemens-Schuckertwerke. January 8th. (Germany, February 2nd, 1918.)
988. "Cables with uniform gradation of voltage drop." Siemens-Schuckertwerke. January 8th. (Germany, September 6th, 1919.)
989. "Arrangement for suppression of earth leakage current of high-voltage networks." Siemens-Schuckertwerke. January 8th. (Germany, May 25th, 1918.)
1,079. "Receiving systems for radio-dynamic energy." J. H. Hammond. January 8th. (United States, June 22nd, 1917.)
1,080. "Receiving systems for radio-dynamic energy." J. H. Hammond. January 8th. (United States, July 31st, 1917.)
1,081. "Receiving systems for radiant energy." J. H. Hammond. January 8th. (United States, April 25th, 1918.)
1,087. "Electric time transmitting apparatus." P. Trichard. January 8th. (France, July 13th, 1917.)
1,089. "Transmitters for signalling." A. W. Sarnmark. January 8th. (Sweden, December 1st, 1919.)
1,103. "Submarine sound receiving plant." Signal Ges. January 8th. (Germany, December 10th, 1914.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1914.

18,042. "Electrically-driven turret lathes and like machines." Kienzle. August 1st, 1913.

1919.

16,310. "Electric resistance for medical purposes." W. A. Montgomery. June 28th, 1919. (155,317.)
19,909. "Electric cable attachment for the sparking plugs of internal-combustion engines." H. F. Holworthy. May 14th, 1920. (155,327.)
20,029. "Circuits for amplifying electric currents." General Electric Co. and B. S. Gossling. August 14th, 1919. (155,328.)
20,043. "Aerial systems employed in wireless telegraphy and telephony." C. S. Franklin. August 14th, 1919. (155,330.)
22,363. "X-ray apparatus." British Thomson-Houston Co. (General Electric Co.). September 10th, 1919. (155,345.)
22,290. "Dynamo-electric machines." E. J. Harman and E. Le Bas. September 10th, 1919. (155,346.)
22,592. "Starting rheostats for electric motors." A. H. Buckley and R. A. Buckley. September 13th, 1918. (132,538.)
23,599. "Electric lamp for motor and other vehicles." S. Smith & Sons and P. O. Dorer. September 25th, 1919. (155,392.)
24,400. "Electric hand lamps." G. Suckling. October 6th, 1919. (155,402.)
24,750. "Locking device for electrical switches." J. A. Vincent. October 10th, 1919. (155,407.)
25,172. "Electric contact maker for railways." N. P. Roe. October 14th, 1919. (155,414.)
30,926. "Junction or connection boxes for electric conductors." R. S. O'Neil. December 10th, 1919. (155,449.)
32,794. "Electrolytic apparatus." I. H. Levin. December 31st, 1919. (155,457.)

1920.

1,840. "Electric induction furnaces." Compagnie Francaine des Metaux. February 7th, 1919. (138,604.)
3,217. "Electric furnaces." L. Tagliaferri. February 2nd, 1920. (155,476.)
3,279. "Electric furnaces for the production of zinc." B. Rader and Aktieselskabet Zink. February 15th, 1919. (139,160.)
4,214. "Electrical apparatus for indicating and repeating movements at a distance." J. L. Routin. January 3rd, 1920. (Addition to 131,635.) (1a5,480.)
5,087. "Driving and transmission mechanism for electrically-operated lifts, swing bridges, and other heavy machinery." Waygood-Otis, Ltd. (Soc. Anon. Ateliers Otis-Fiifre). February 19th, 1920. (Patent of addition not granted.) (155,484.)
8,694. "Means for measuring wattless power or wattless consumption in alternating current circuits." Landis & Gyr Akt.-Ges. March 25th, 1919. (Addition to 3,856/15.) (140,785.)
9,612. "Carrier or means for supporting electric lamp or other shades, reflectors, and the like." A. P. Rutherford. April 6th, 1920. (155,409.)
12,229. "Time controlled electric circuit controllers." G. L. Hall. May 3rd, 1920. (155,504.)
14,433. "Electric starting and regulating switches." G. O. Donovan. May 27th, 1920. (155,509.)
16,679. "Metal brushes for use in connection with electric switches for controlling train movements." N. P. Roe. June 21st, 1920. (155,516.)
16,682. "Electric contact breaker for railways." N. P. Roe. June 21st, 1920. (Addition to 155,414.) (155,518.)
16,683. "Bracket for attaching electric contact breaker to locomotives." N. P. Roe. June 21st, 1920. (155,519.)
16,834. "Electrical switches for liquid starters." Siemens-Schuckertwerke. August 30th, 1918. (145,507.)
17,226. "Methods and apparatus for use in submarine signalling." R. A. Fessenden. November 29th, 1918. (146,152.)
18,021. "Distant control of apparatus in accordance with the electrically-transmitted movements of a pointer or the like." F. Krupp Akt.-Ges. September 30th, 1916. (145,723.)
18,027. "Distant control of apparatus in accordance with the electrically transmitted movements of a pointer or the like." F. Krupp Akt.-Ges. May 18th, 1915. (145,729.)
18,248. "Distant control of apparatus in accordance with the electrically transmitted movements of a pointer or the like." F. Krupp Akt.-Ges. November 6th, 1916. (Addition to 145,729.) (146,315.)
19,107. "Voltage regulator." F. Munz. April 4th, 1919. (147,088.)
19,365. "Fire extinguishing process and device for burning transformers and similar apparatus." C. Graaff. December 31st, 1919. (155,524.)
20,406. "Arc lamps for searchlights." Optische Anstalt C.P. Goerz Akt.-Ges. October 14th, 1918. (148,451.)

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